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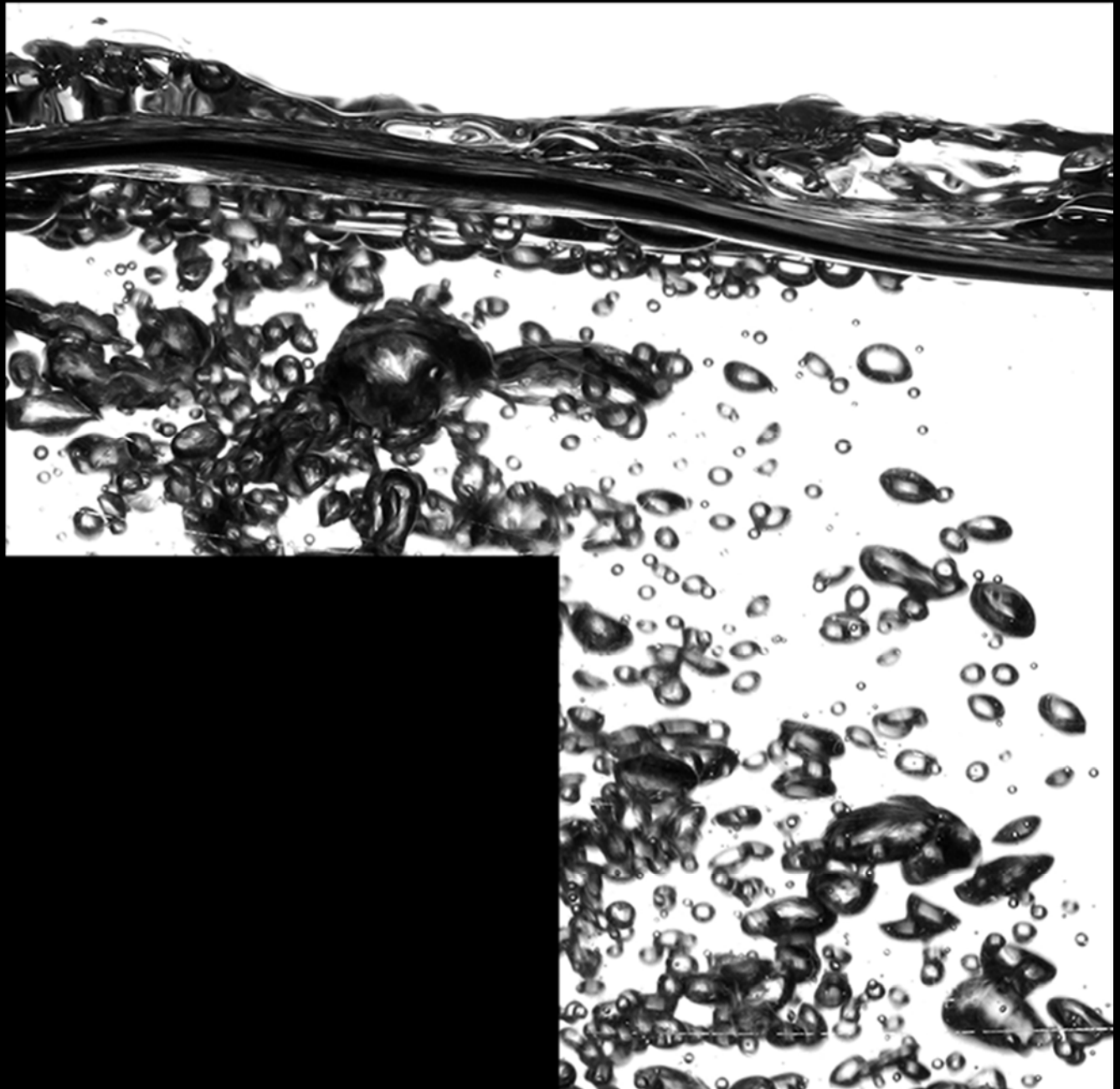
APPENDIX B

Three Waters Assessment

T4 STRUCTURE PLAN

Three Waters Assessment

Lyn Cudby and LY&NZ Investments Limited





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1.0 INTRODUCTION

This 3-waters assessment has been prepared to support a plan change of the Te Awamutu T4 Growth Cell from 'Deferred Residential' to 'Medium Density Residential Zone'. The T4 Growth Cell is approximately 29 Ha of existing farmland being bordered by the North Island Main Trunk (NIMT) railway to the west, residential properties to the east and farmland to the south.

This report covers stormwater, water and wastewater requirements and highlights available infrastructure, constraints, and possible solutions for the development of the T4 Growth Cell as a residential subdivision. The purpose of this assessment is to demonstrate that the plan change area can be appropriately serviced from a three waters perspective.

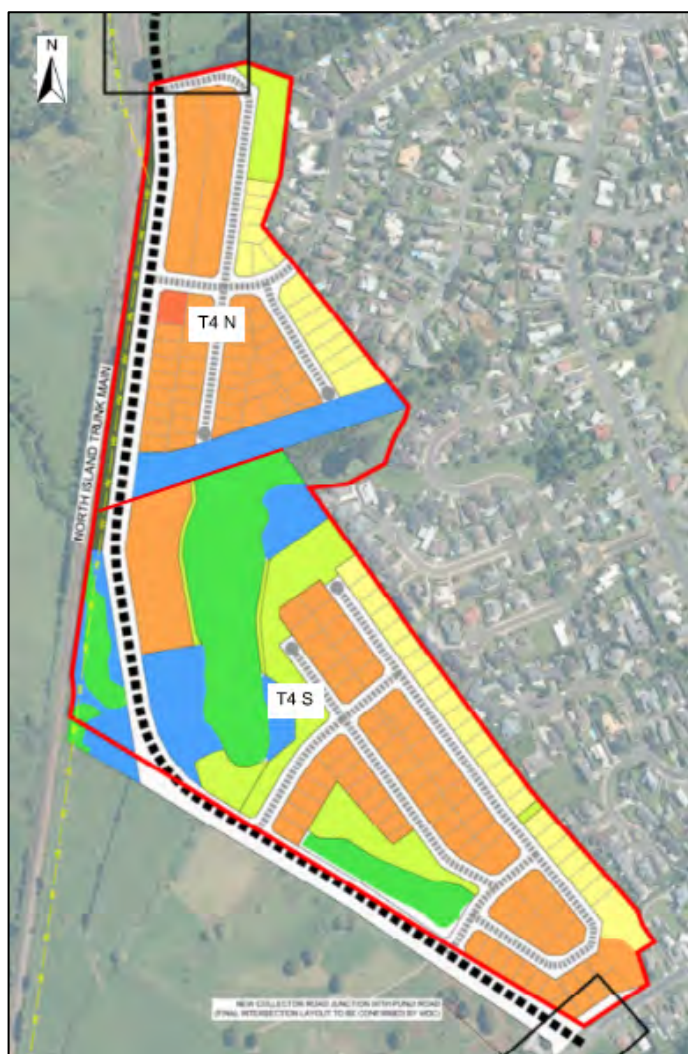


FIGURE 1 T4 PROPOSED GROWTH CELL STRUCTURE PLAN

The assessment is based on a review of the available information on the T4 Growth Cell, consultation with local council, information provided by other consultants, and information provided by the client.

The information has been obtained from the following sources:

- Waipa District Council (WDC) – website and GIS maps
- Waikato Regional Council (WRC) – online GIS hazard maps
- Water and Wastewater Infrastructure Assessment, WSP in support of Plan Change 26 (PC26) (9/8/2022)
- Information provided by the client,
- Information provided from consultation with WDC staff.
- Information provided by other consultants.
- Water and Wastewater Modelling reports prepared by WSP Consultants (November 2023 – attached in Appendix 4 and Appendix 5)

The T4 Growth Cell is made up of two properties, with separate owners. Lyn Cudby is the owner of the southern land block within the T4 growth cell (approx. 18 Ha) and LY&NZ Investment Limited is the owner of the northern land parcel. Subsequent to our appointment, Lyn Cudby formed an agreement with LY&NZ. Under the terms of their agreement, we understand Lyn Cudby and LY&NZ Investment Limited have agreed to jointly be one party for the purposes of technical assessments and for the private plan change application. Our assessment has considered the possibility that one of the property owners may develop their property before the other.

The properties are listed in Table 1 and referred to as T4 North (T4N) and T4 South (T4S) in this report.

TABLE 1: T4 Growth Cell				
PROPERTY	PROPOERTY OWNER	SIZE	APPELLATION	PROPOSED LOTS
T4 North	LY&NZ Investment Limited	8.9 Ha	Lot 2 DPS 18699	74
T4 South	Lyn Cudby	18.25 Ha	Part Lot 1 DPS 10432	118

2.0 STORMWATER

2.1 TERRAIN AND EXISTING DRAINAGE

Currently the T4 Growth Cell consists of two separately owned farms; the northern half of T4N slopes east to west with the southern half sloping to the south. The southern half of T4S slopes to the south and the northern half of the lot has a stream running north to south through the centre of the lot.

The northern farm currently takes overland flow from Wallace Terrace, this outlets onto paddocks and there are no streams or drains.

The southern lot has three streams which join south of the lots and outlet into the Puniu River (Figure 2).

The southern lot takes some overland flows directly from the northern lot and from the adjacent residential lots south of Lola Lee Heights.

Numerous natural wetlands and ponds have been identified on the T4S portion along the stream banks. These natural wetlands and ponds are identified in Figure 3.



FIGURE 2 EXISTING DRAINS (WAIPA DC GIS MAPS)



FIGURE 3 NATURAL INLAND WETLANDS (MORPHUM ENVIRONMENTAL)

2.2 FLOOD HAZARDS

A preliminary assessment of the flood risks was carried out by Waipa District Council's preferred stormwater modelling consultant (Te Miro Water Ltd) to address the flood risks within the site and downstream of the development. A copy of the memo is appended to this report.

As shown in Figure 4, there are some existing areas of flooding within the site for the 1% AEP storm events. There is flooding on the flat fields in the northern part of T4N where the railway culvert restricts flow to the west. There is also some shallow flooding in the southern portion of T4S where there is an existing overland flow path from the residential areas discharging from Meddings Crescent. Generally, the flooding within the growth cell is contained within the existing drains.

Downstream of the growth cell there is a large area of flooding in two locations. This is a result of stormwater flows being restricted by the NIMT railway culverts. The sizes of these culverts are currently unknown and modelled as the same diameter as the culvert crossing the railway from T4N.

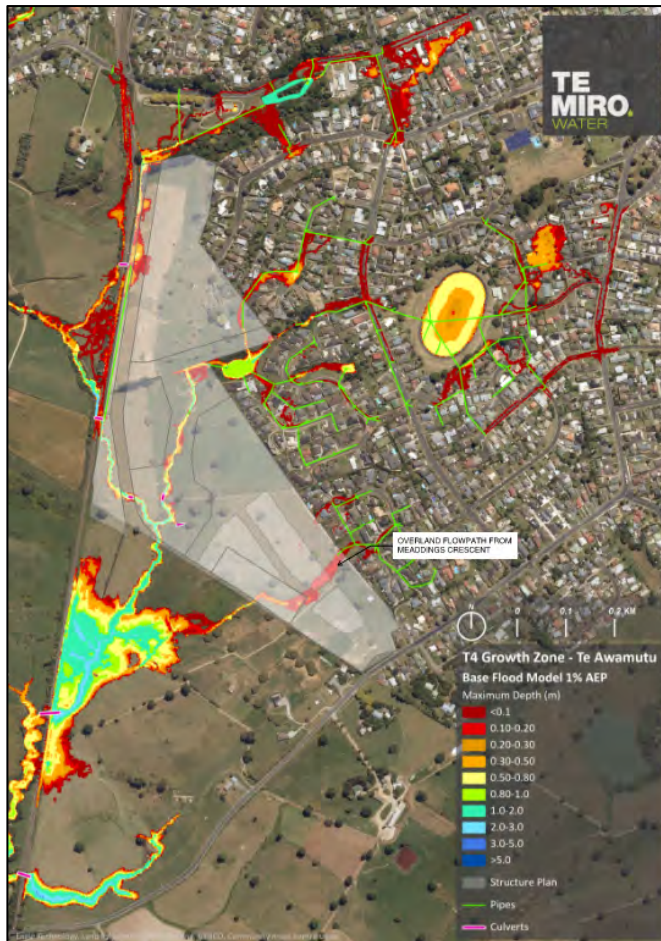


FIGURE 4 PRE-DEVELOPMENT FLOODING ZONES (TE MIRO WATER)

2.3 STORMWATER MANAGEMENT

As per the regional guidelines, stormwater runoff from any development will need to be treated to acceptable standards before discharge from the site.

The regional guidelines also require that post-development stormwater flows are managed within the development to ensure that there is no peak flow increase downstream of the development.

The site has existing wetlands (Figure 3), these will be retained where possible but will not form part of the development's stormwater management system. The portions that are unavoidably impacted by the development (eg. for the construction of roads for access) will be replaced by additional wetlands adjacent to the existing natural wetlands, with an overall increase in wetland area post-development.

2.3.1 RECOMMENDED APPROACH

The Geotechnical Investigation Report prepared by CMW (31/07/2023) has indicated that the site would generally be suitable for stormwater disposal to ground by soakage. This has not been confirmed for the entire site and additional testing is required to confidently propose stormwater disposal by soakage as a workable solution. For this initial assessment we have proposed utilising artificial wetlands for stormwater management. This approach aligns well with the existing terrain and natural drainage features found within the site.

During future design stages of the development, stormwater management may include on-lot stormwater devices, swales, soakage systems and roof water detention and reuse tanks.

Initial sizing of the artificial wetlands has been determined using 4% of the catchment area to size the permanent water surface area of the wetlands. This is a conservative method for initial sizing of wetlands recommended by the WRC Stormwater Management Guide for impervious areas greater than 70%.

A summary of the wetland sizes and catchments is shown in Table 2, Figure 5 and in drawing A2213321.00-HG-DR-SK-014 in the appendices.

TABLE 2: ARTIFICIAL WETLAND SUMMARY			
WETLAND	CATCHMENT AREA (HA)	RECOMMENDED 4% WETLAND AREA (M2)	ARTIFICIAL WETLAND AREA PROVIDED (M2)
Northern Artificial Wetland 1	8.3	3,320	6,780
Southern Artificial Wetland 1	8.0	3,200	3,180
Southern Artificial Wetland 2	2.9	1,160	1,430
Southern Artificial Wetland 3	1.7	680	1,410
Southern Artificial Wetland 4	1.5	600	690

Initial placement of the artificial wetlands in the growth cell has been to place them off-line along the natural drainage lines as this is the natural low point for drainage and the wetlands will have controlled discharge into the farm drains, new constructed wetlands or existing natural wetlands.

The urban design has created a stormwater reserve around the existing drain and wetland areas. The artificial wetlands are within this reserve and will create an attractive amenity zone. The wetlands will add ecological value to this zone and attract aquatic fauna.

The stormwater flows up to the 10-year storm events would be conveyed within a gravity piped network within the road reserves discharging into the artificial wetlands. The site will require earthwork contouring to ensure there is adequate fall to ensure a piped network is able to convey stormwater to the artificial wetlands. McCaffrey and Cable Consulting (MaCC) have prepared a preliminary earthworks model that has been used to test the pipe networks to the artificial wetlands.



FIGURE 5 T4 ARTIFICIAL AND NATURAL WETLANDS (T4 DRAWING SET)

Storm events above the 10-year event would be conveyed overland within the road reserve to the stormwater reserves. Te Miro Water have used the proposed T4 layout plan to run a post development flood model to address the post development flood risks. The report is included in the appendices. The MaCC earthworks model was used to identify overland flow discharge locations within the stormwater reserve areas. (Note: the Te Miro report and assessment was carried out using an earlier layout and earthworks model. The current layout has reduced impervious catchments which will result in a slight reduction to the model results in the Te Miro report, making the Te Miro assessment conservative at present)

The Te Miro model has allowed for unrestricted flow through the future culverts under the proposed road network. The model was also unable to incorporate the preliminary digital earthworks design into the model. The catchment stormwater flows were however included in the model as discharge nodes at the locations identified in the earthworks model. This means that the post-development flood results do not accurately represent the flooding within the earthworked portions of the growth cell, but accurately represent any flooding outside of these areas, within the stormwater reserve, the existing residential areas and the paddocks outside of the growth cell area. The results of the flood modelling show that there is an insignificant increase in flooding or flood risk downstream of the site for the 2, 10 or 100-year storm events.

The flooding identified in T4N at the NIMT culvert crossing will need to be managed with a diversion swale between the NIMT and the collector road. The swale will be sized to convey any excess runoff that exceeds the capacity of the NIMT Culvert and will discharge these flows back into the stream after the southern NIMT culvert crossing in T4S as shown in Figure 6. This swale will also mitigate the existing flooding across the NIMT railway line evident pre-development.

As the flood risk downstream of the site shows a minor increase by the development the artificial wetlands will not provide detention. However, as the detailed design progresses

there may be benefit in using the proposed collector road culverts to attenuate the 2 and 10 year storm events within the stormwater reserve.

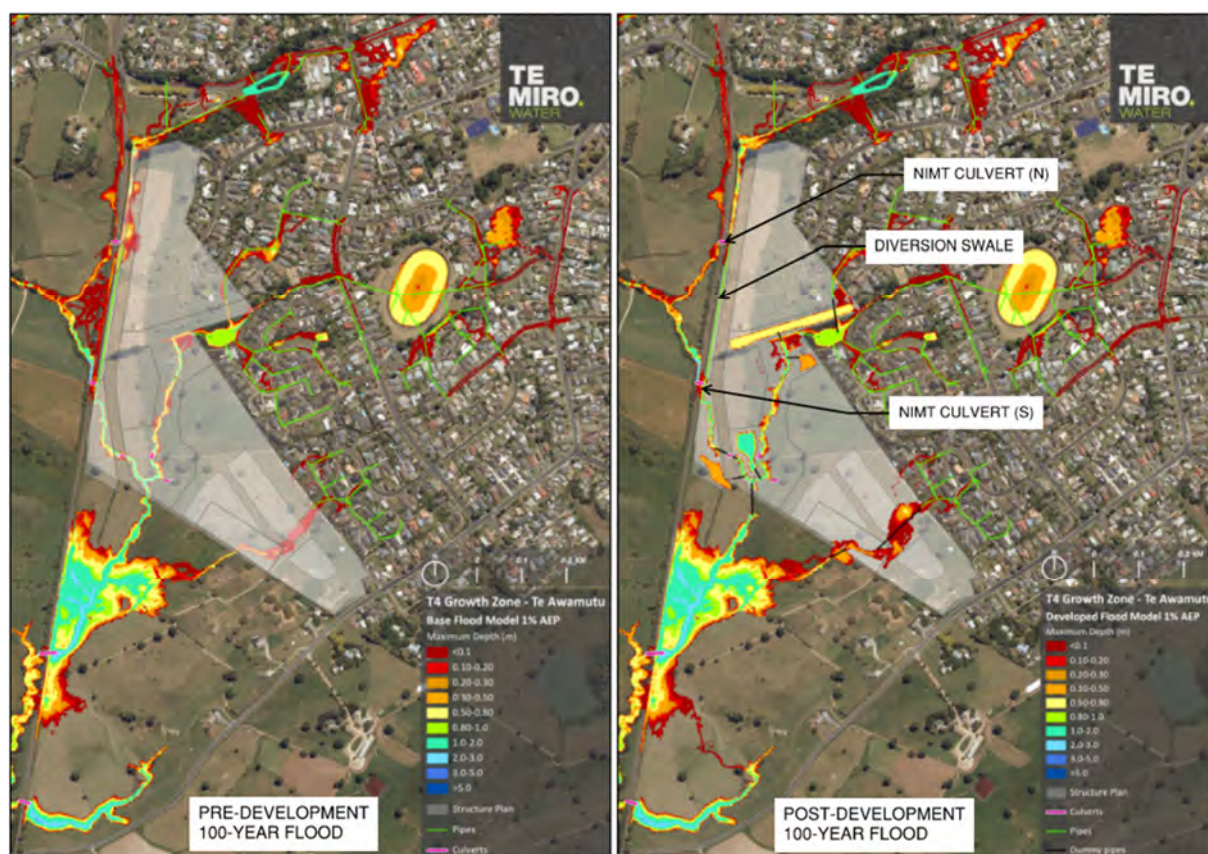


FIGURE 6 PRE AND POST DEVELOPMENT FLOOD RESULTS (100 YEAR EVENT)

2.4 STORMWATER CONSTRAINTS

Initial constraints that will need to be further investigated as the designs for the T4 Growth Cell proceed include:

- The lots and roads will need to be designed to ensure overland flows are off the lots, along the roads to the wetlands.
- The lots and roads will need to be designed to ensure stormwater pipes have adequate cover.
- Geotechnical input to determine soakage capacity across the development to allow the possible inclusion of stormwater soakage devices across the development with a resulting reduction in the sizing of artificial wetlands.
- Should the T4N portion be developed first, management of the flooding near the northern NIMT railway culvert would need to be incorporated into the designs. This would either be as a temporary flood management device within T4N or the diversion swale would need to be constructed into the T4S portion to allow flood runoff to be conveyed into the stream within the T4S property. The final solution would be designed as part of the resource consent and engineering approval stages of the development. (T4S can be developed prior to T4N without impacting the existing T4N stormwater and flooding).

2.5 FURTHER INVESTIGATION

As development of the master plan progresses, more detailed geotechnical investigation will be required, with specific focus on groundwater dispersal and hydraulic conductivity before final designs are carried out to identify suitable locations to include stormwater soakage.

Stormwater design and modelling will also be required to accurately detail and size the stormwater devices, address the feasibility of attenuation within the stormwater reserve and identify any flood risks within the final landform design.

3.0 WASTEWATER

The wastewater assessment is based on the layout prepared by MaCC and their preliminary landform model. The assessment addresses the possibility of either portion of T4 developing independently of the other.

3.1 EXISTING WASTEWATER SYSTEMS

The T4 Growth Cell is outside of the Te Awamutu gravity network area. All of the adjacent network is small diameter gravity pipes falling towards small wastewater pumpstations. The Te Awamutu wastewater treatment plant is located approximately 2.7km northwest of the site (Figure 7).

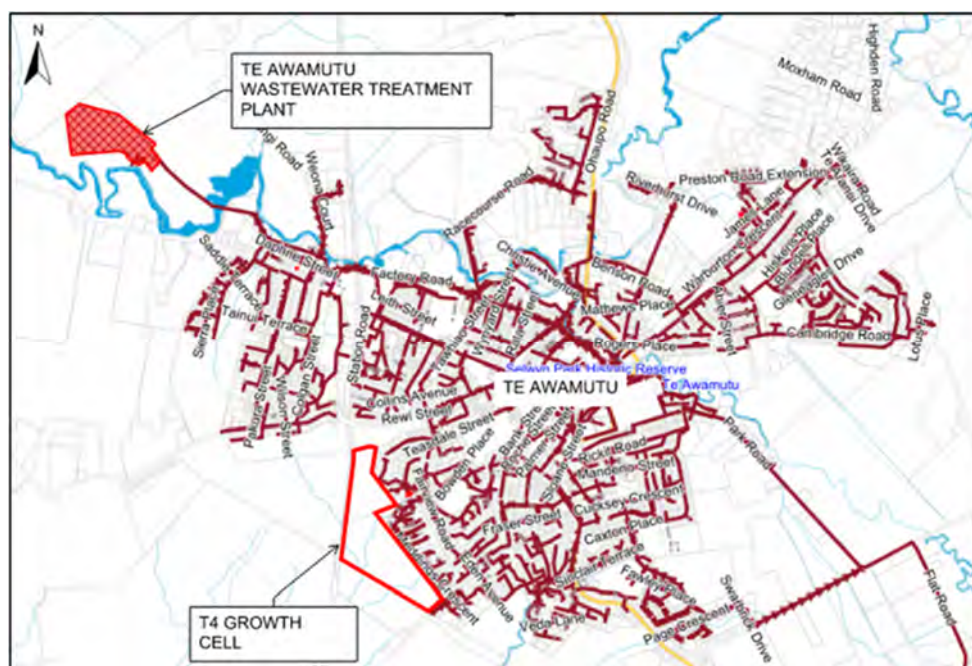


FIGURE 7 EXISTING WASTEWATER LOCATIONS

The site is generally at a lower elevation than the adjacent network and only a small portion at the southern end of T4S would be able to connect via gravity to the existing system. WDC have indicated that the Puniu wastewater pump station (Figure 8) and downstream infrastructure is at capacity and has not been considered to be a viable option.

The assessment carried out by WSP regarding the proposed densification of properties under Plan Change 26 (PC26) has highlighted that the existing networks would be strained once the plan change takes effect. The result being that planned strategic upgrades would likely be brought forward to accommodate the densification of Te Awamutu.

WSP were engaged to assess the existing network capacity for possible discharge locations for the T4 development. A summary of the findings is in Section 3.3 and the WSP report included in Appendix 4



FIGURE 8 WASTEWATER INFORMATION

3.2 WASTEWATER FLOW

The base demand for the T4 Growth Cell development has been based on the requirements of the RITS' base demand of 200l/person/day and 2.7 persons/dwelling for the T4 layout. The T4 Plan Change proposal to rezone the T4 Growth Cell to Medium Density Residential Zone. If accepted, this would allow up to two dwellings per lot, effectively doubling the population per lot to 5.4 persons/lot.

The expected flows based on 5.4 persons per lot are detailed in Table 3.

TABLE 3: WASTEWATER DESIGN FLOWS - MEDIUM DENSITY RESIDENTIAL					
GROWTH CELL PORTION	AREA (HA)	NUMBER OF LOTS	POPULATION	AVERAGE DAILY FLOW (M3/DAY)	PEAK WET WEATHER FLOW (L/S)
T4N	8.99	74	400	100	5.2
T4S	18.25	118	638	169	8.7
Total¹	27.24	192	1,037	268.7	13.1

It is worth noting that the predicted population density for T4 is 38 people/Ha. While this is higher than the 27 people/Ha currently modelled it is significantly less than the expected 54-68 People/Ha anticipated in the WSP infrastructure assessment prepared as part of the PC26 process.

¹ Note: The total peak flows shown above are for the combined flows from both lots where the peaking factor is reduced as per Table 5-2 of the RITS.

3.2.1 CONVEYANCE

Conveyance is largely dependent on the topography. The preferred method of wastewater collection for development sites is by gravity flow through small diameter pipes, which are connected to bulk collector pipes and ultimately drain via gravity to a wastewater treatment plant.

Where the terrain is relatively flat these gravity lines tend to become very deep. In these situations, the costs and logistics of constructing deep gravity lines makes them unfeasible and wastewater pump stations are used to collect and lift effluent to a point where it can join a gravity main and flow to the treatment plant.

For the purposes of this assessment, we have used the MaCC preliminary landform model to assess the gravity network and identify wastewater pumpstation locations. The preliminary networks have used three criteria to check the network. Minimum cover of 1m and a maximum gravity pipe depth of 5m. The resulting pipe networks have then been checked to ensure that they meet the minimum pipe grades as set out in the RITS.

Our assessment has identified three possible solutions:

OPTION 1 (FIGURE 9)

T4N and T4S have independent gravity networks connected to a wastewater pump station with a rising main located within each property. T4N would have the rising main running north via Wallace Terrace and T4S would have a rising main running south then via Puniu Road. Both rising mains will discharge to the existing gravity network at a location that has available residual capacity.

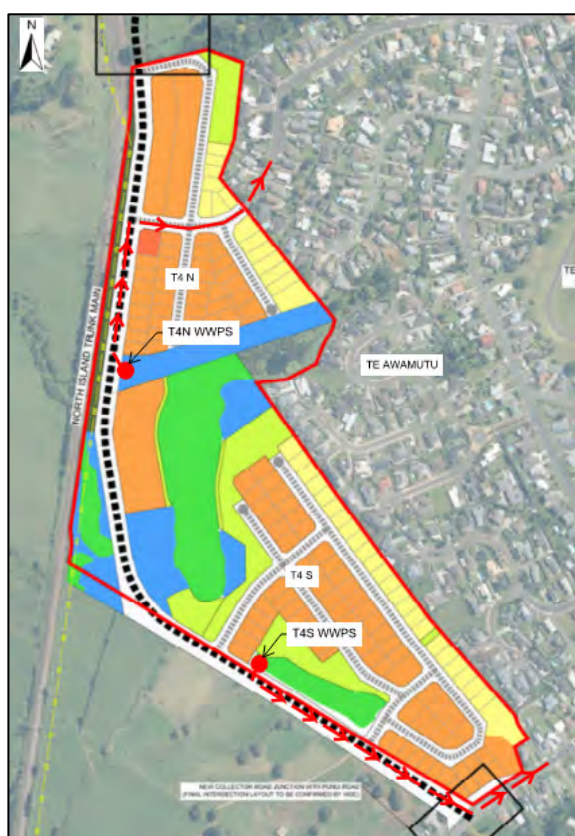


FIGURE 9 OPTION 1 INDEPENDENT NETWORKS NORTH AND SOUTH (INDICATIVE WWPS LOCATIONS)

OPTION 2 (FIGURE 10)

This option is the same as Option 1, however one of the pumpstations would become the terminal wastewater pump station and the other would be a satellite wastewater pumpstation. The satellite wastewater pumpstation would collect wastewater from within their property and pump it to the terminal wastewater pumpstation. The terminal wastewater pumpstation will pump waste via a rising main conveying the wastewater from the entire T4 Growth Cell, discharging to a manhole within the existing gravity network. The selection of the terminal wastewater pump station would be based on the first property to be developed and would need to have adequate capacity to include wastewater from the remaining lot's satellite wastewater pumpstation when that portion is developed.

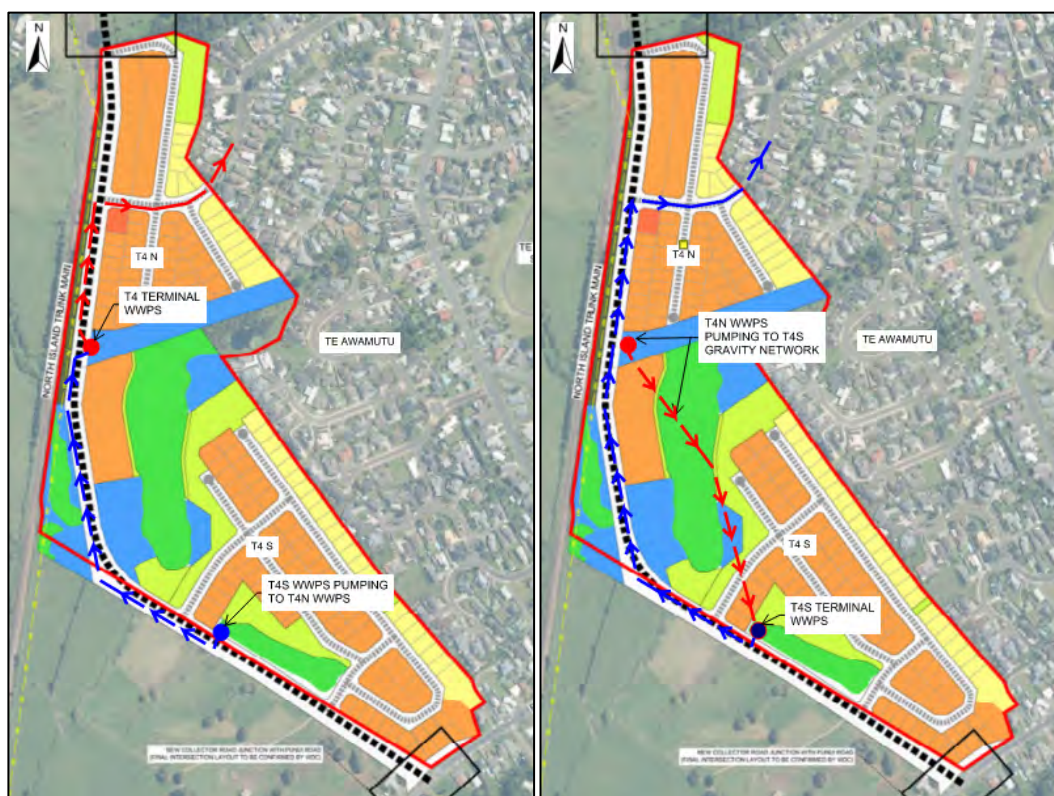


FIGURE 10 OPTION 2 SHOWING T4N DEVELOPED FIRST (LHS) AND T4S DEVELOPED FIRST (RHS) (WWPS AND RISING MAINS ARE INDICATIVE)

OPTION 3 (FIGURE 11)

The entire growth cell conveys wastewater via a gravity network to a single terminal wastewater pumpstation located within T4S. This pumpstation will convey all the wastewater for the growth cell to a location within the existing gravity network. This option will not be feasible if T4N develops first without the construction of the terminal pumpstation on T4S.

The rising main discharge location(s) has not been identified yet. A request has been submitted to WDC to run their wastewater model to identify the connection location and any possible upgrades required to accommodate the wastewater from the T4 Growth Cell.

It is understood that the wastewater pumpstation on Puniu Road and the downstream Kerikeri wastewater pumpstation have limited available capacity. The expectation is that the combined wastewater flows would exceed any available capacity to the south and a the combined rising main would discharge to the north, towards the wastewater treatment plant.



FIGURE 11 SINGLE WWPS FOR T4 GROWTH CELL (WWPS AND RISING MAINS ARE INDICATIVE)

3.3 WASTEWATER NETWORK ASSESSMENT

3.3.1 WSP NETWORK ASSESSMENT

WSP have built and manage the wastewater model for Te Awamutu. They were engaged by the client to carry out an assessment of the available capacity of the network to assess the options proposed in Section 3.2.1.

The WSP reports are included in Appendix 4. The report assessed multiple T4 wastewater discharge locations within the existing network adjacent to the site. Overall, the existing network was found to be at or near capacity. WSP's preferred solution was to store peak flows at the pumpstation and have controlled discharge into the network. This was tested by WSP at 7 l/s from the pumpstation discharging to a manhole in Wallace Terrace. However, even at 7 l/s, half the expected peak wet weather flow, the model indicated that the existing network would be inundated and overflow at 2 locations (Figure 12).

The proposal of providing a wastewater solution based on providing storage of peak flows is not favoured by WDC.

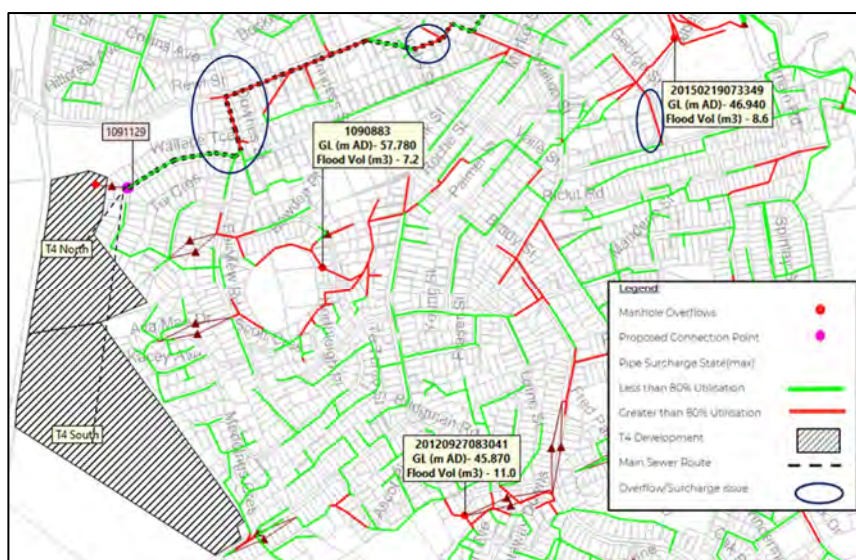


FIGURE 12 NETWORK ASSESSMENT AT 7L/S PUMPED TO WALLACE TERRACE (WSP 2023)

3.3.2 HG NETWORK ASSESSMENT

As a wastewater solution using storage is not a viable solution we have identified alternative options.

1. OPTION 1 – UPGRADE EXISTING NETWORK

Figure 13 shows the existing network has sections of pipe that are currently already exceeding 80% capacity along Rewi Street. This is likely the bottleneck that is causing the overflows when flows from T4 are added to the network.

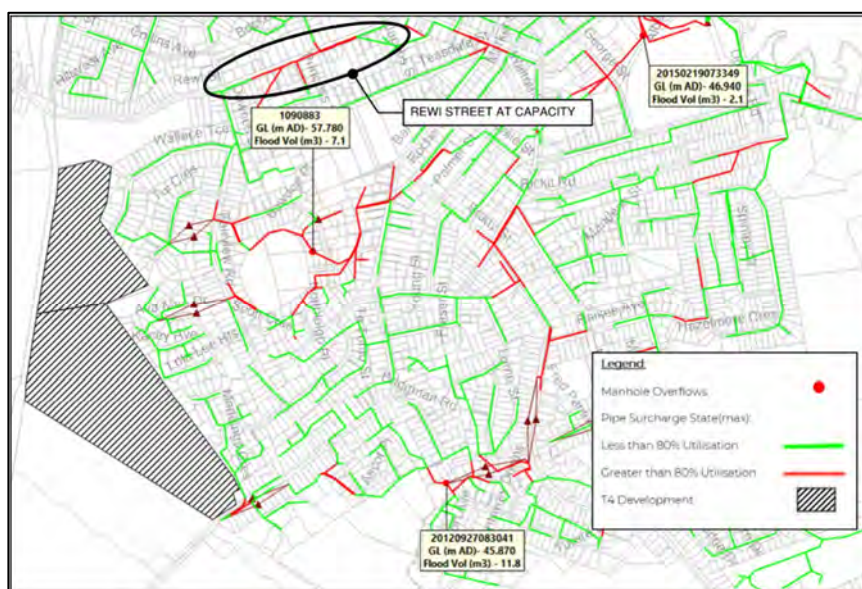


FIGURE 13 EXISTING NETWORK BASE FLOW (WSP 2023)

We have carried out a hydraulic assessment of this section using the following information:

- WDC GIS information to determine pipe grades and lot numbers
- Existing flows based on 3 people per lot²,
- 200 L/person/day and

² This was increased to 45 people/Ha to provide a more conservative assessment

- An average catchment area of 2,200m²/lot to calculate ingress and infiltration (and population).
- RITS values for infiltration and surface water ingress

Using this information we have carried out a spreadsheet calculation of flows within the network. The calculations are included in Appendix 6.

Our calculated results indicate that there should be no capacity issues in the network pre-development with the exception of a section of pipe flowing to Alexander Street. The GIS information shows this section of pipe is laid at 0.04% (Figure 14) (this is not identified by WSP as having any pre-development flow constraints).

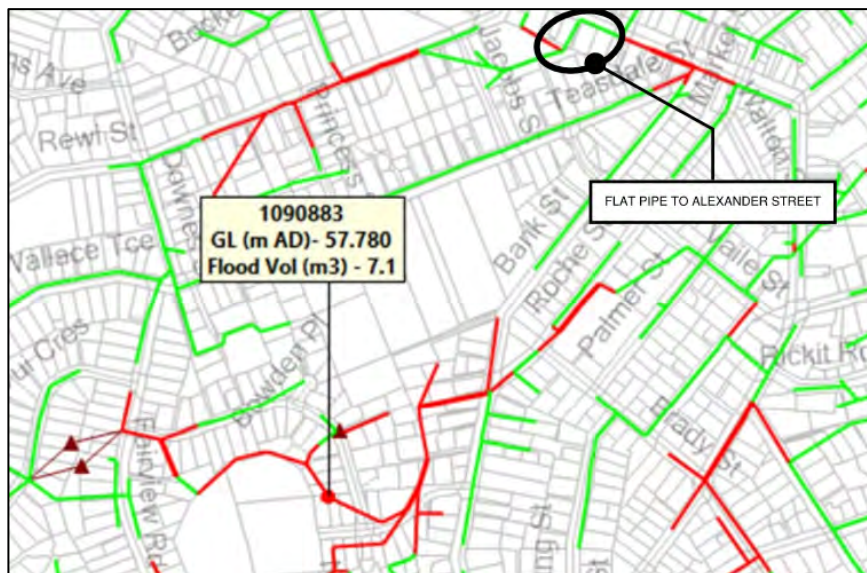


FIGURE 14 FLAT SECTION OF PIPE

We have added 13.1l/s into our spreadsheet as a base flow from the proposed T4 WWPS and this results in the first three sections of Wallace terrace and all the pipes on Rewi Street being under sized.

To address the capacity issues, we have carried out an assessment with upgraded pipes in Rewi Street. The pipes would need to be upgraded to 225mm diameter pipes and the existing grade retained. The result being that all the pipes flow at less than 65% capacity once the 13.1 l/s has been added to the network.

The capacity constraint for the first three sections of network in Wallace Terrace are laid at minimum grade. To avoid having to upgrade these pipes we propose discharging the T4 flows into the end of this section (Figure 15). This would add an additional 200m to the rising main length.

The flat pipe section through to Alexandra Street would need to be investigated to confirm grade. There is an opportunity to regrade this section (and the next downstream section) to average the grades. The next section of pipe is shown as being laid at 1%, averaging the fall across these two sections would resolve the flow constraints based on our calculations.

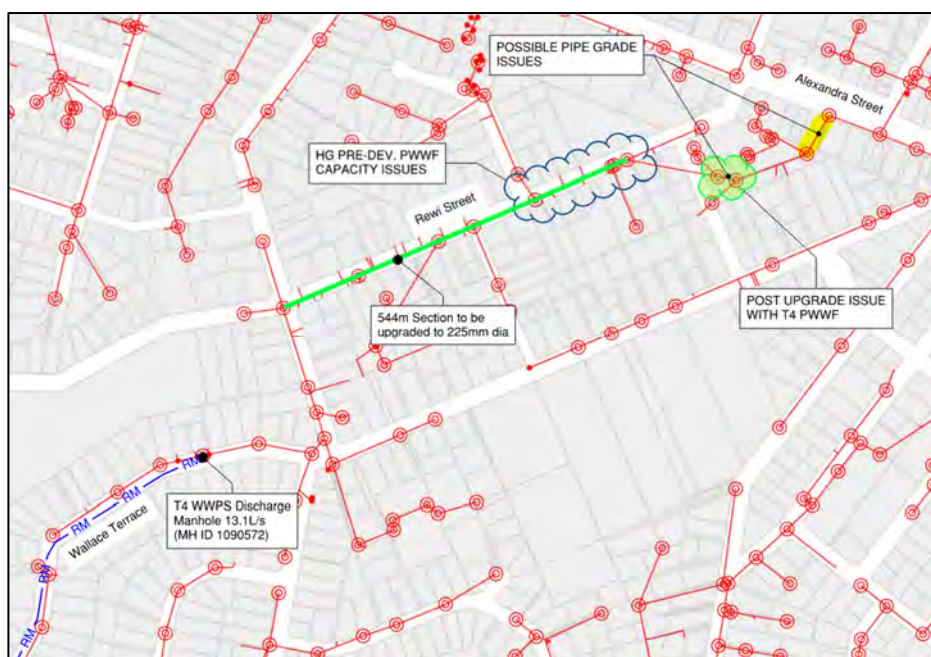


FIGURE 15 PROPOSED NETWORK UPGRADES (OPTION 1)

2. OPTION 2 – RISING MAIN TO FACTORY ROAD

The second option we have investigated is to identify an alternative rising main discharge location. The gravity main on Factory Road is a 600mm diameter pipe. We have assumed that there is capacity within this pipe to receive an additional 13.1l/s.

This proposed option is to pump the full 13.1l/s directly to this pipe. The proposed route is shown in Figure 16 below. The length of the rising main is between 1,500m and 2,200m long depending on the location of the T4 terminal wastewater pumpstation.

WDC have confirmed that this section of trunk main is operates under pressure. The pumpstation would need to be designed to overcome the additional pressure head in the trunk main. A preliminary assessment was carried out using the longest rising main length and a pipe diameter of 125mm internal diameter.

The preliminary rising main long section (included in the appendices) shows there is a small static head difference, in the order of approximately 3m (excluding the trunk main pressure) and friction losses of 27m. These are relatively common pump demands and correct pump selection to overcome the trunk main pressure would be feasible.

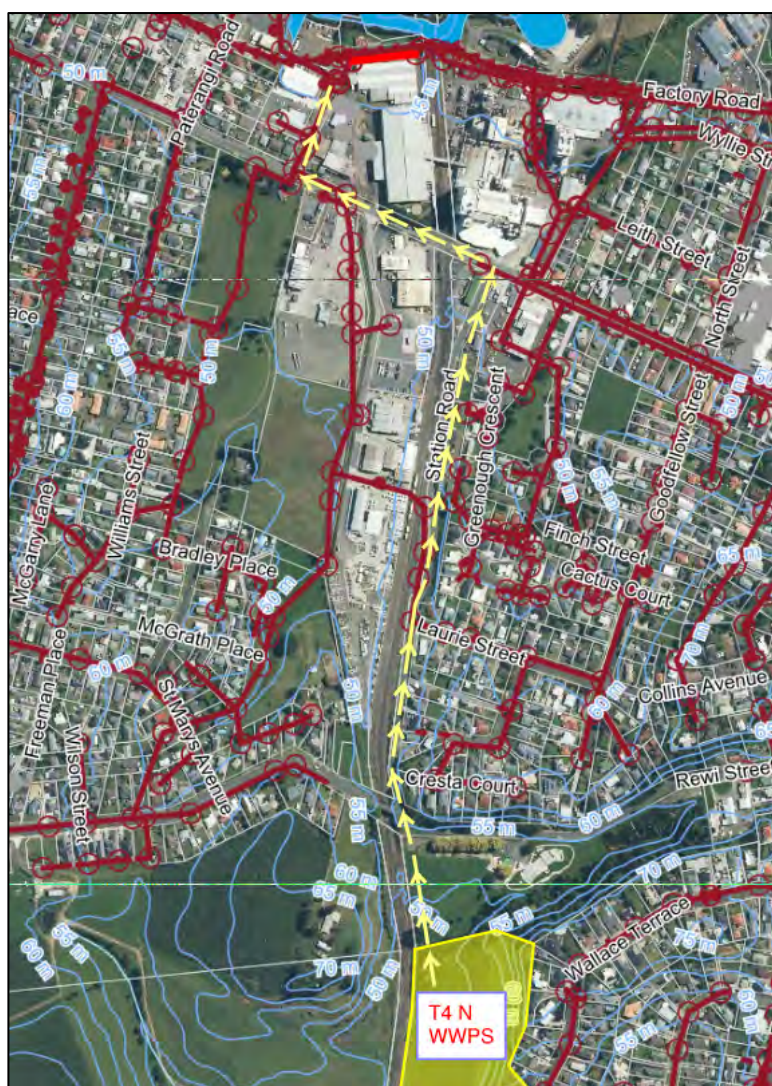


FIGURE 16 OPTION 2 RISING MAIN

3.4 WASTEWATER SOLUTION

Based on our findings we conclude that either of the two options are able to service the proposed development. Both options have merits and constraints. The final solution will be determined during the detailed design stage.

4.0 WATER SUPPLY

4.1 EXISTING WATER SUPPLY

The existing water supply networks are shown in Figure 17. The T4 Growth Cell currently has no water connections. There is a 200mm dia. main in Rewi Street, north of the site and a 200mm dia. pipe to the south in Puniu road. There are 100mm dia. pipes located in Wallace terrace and Meddings Crescent.

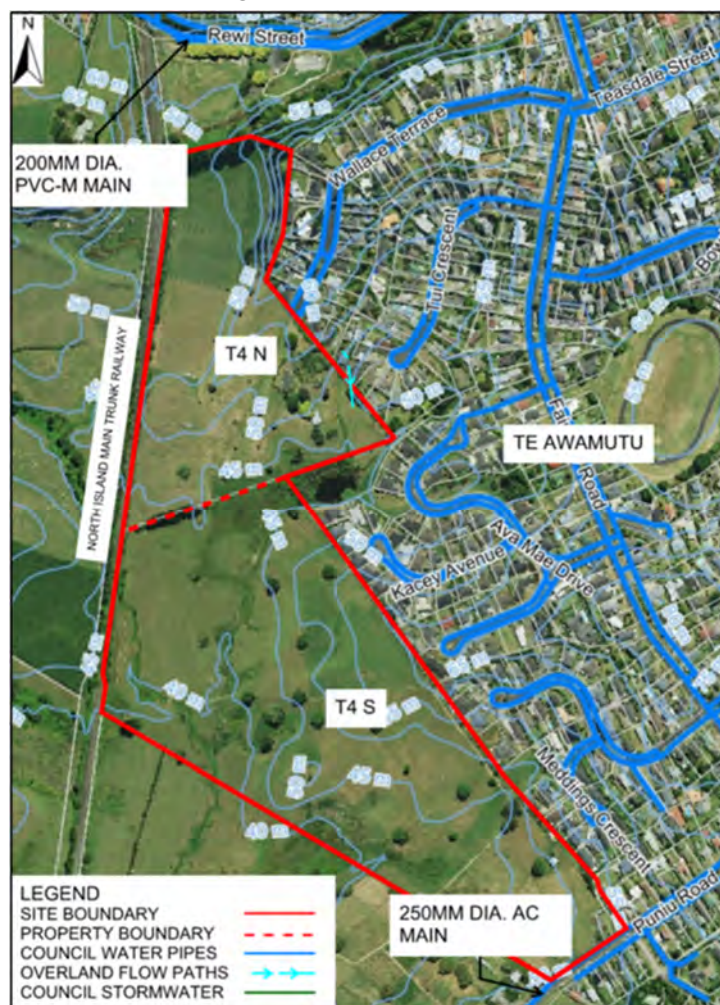


FIGURE 17 EXISTING WATER SUPPLY NETWORK

4.2 DEMAND AND SUPPLY

The RITS standards for residential development recommend a population equivalent rate of 2.7 persons/dwelling and a daily demand of 260 l/person/day and a peak factor of 5.

Table 4 below, gives a summary of water demand based on the RITS, increased to 5.4 people per lot to allow for Medium Density Residential zoning.

TABLE 4: WATER DEMAND & FLOWS - MEDIUM DENSITY RESIDENTIAL

GROWTH CELL PORTION	AREA (HA)	NUMBER OF LOTS	POPULATION (5.4 PERSON/LOT)	AVERAGE DAILY DEMAND (m ³ /D)	PEAK FLOW (l/s)	FIRE FLOW (l/s)
T4N	8.99	74	400	104	6.0	28.6
T4S	18.25	118	638	166	9.6	30.8
Total	27.24	192	1,037	270	15.6	34.4

4.3 HYDRAULIC MODELLING ASSESSMENT

As part of this assessment, the Client engaged WSP through WDC to carry out a water supply modelling assessment. A copy of the assessment memo is included in Appendix 5.

The water demands and development options were provided to WSP to include into their water model runs and identify capacity and confirm preferred connection locations.

We also requested that the model be run under the following conditions:

- T4N is supplied from a connection to the Wallace Terrace water supply.
- T4S supplied from the main in Puniu Road.
(This will allow either lot to be developed independent of the other. The demands being higher for T4S may require a second connection off Meddings Crescent.)
- An alternative supply point for T4N would be to connect to the main on Rewi Street.
- Ultimately the T4N and T4S networks will be combined creating a looped connection from Puniu Road to Wallace Terrace or Rewi Street.

The proposed water supply layout is provided in drawing A2213321.00-HG-DR-SK009 in the appendices.

4.3.1 WSP HYDRAULIC MODELLING OUTCOMES

The model results indicated that there are multiple options to supply the T4 Growth Cell, however, some of the options had a greater impact on the residual pressures within the adjacent network.

The preferred option is to supply the growth cell with a DN180PE (150mm ID) connection from Rewi Street and from Puniu Road for T4N and T4S respectively (Figure 18).

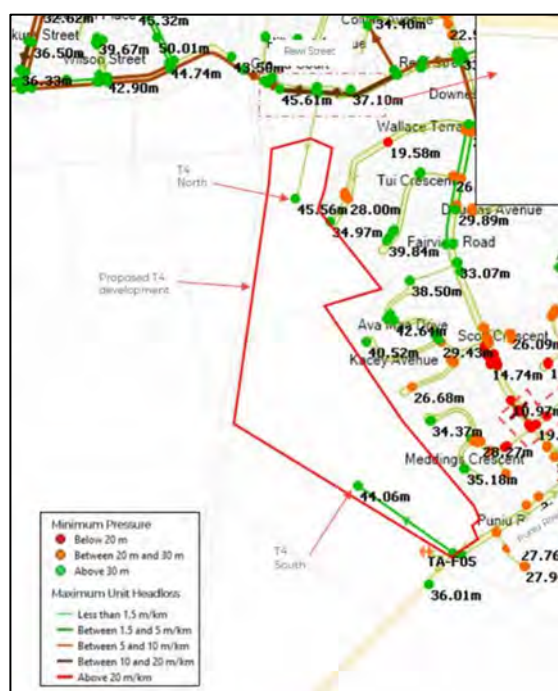


FIGURE 18 PREFERRED WATER SUPPLY OPTION (WSP WATER MODEL REPORT)

The connections are able to service either portion independently allowing either landowner to develop independent of the other. The water networks would be required to extend to the boundary of each lot (T4N and T4S) to ultimately create a looped network from Rewi Street to Puniu Road through the T4 Growth Cell.

WSP have recommended that additional modelling be carried out with the internal water supply network included once the lot layout and designed landform elevations are confirmed. This may allow the T4N development to be independently supplied from Wallace Terrace without the need to connect to Rewi Street.

5.0 CONCLUSION

This report has identified suitable infrastructure solutions for the proposed development that are technically feasible and comply with the Waipa District and Waikato Regional Council requirements.

It is our opinion that from a technical 3-waters infrastructure perspective there are suitable options to service the development and there is no reason (from a 3-waters perspective) why the proposed plan change could not proceed.

6.0 LIMITATIONS

6.1 GENERAL

This report is for the use by Lyn Cudby and LY&NZ Investments Limited only, and should not be used or relied upon by any other person or entity or for any other project.

This report has been prepared for the particular project described to us and its extent is limited to the scope of work agreed between the client and Harrison Grierson Consultants Limited. No responsibility is accepted by Harrison Grierson Consultants Limited or its directors, servants, agents, staff or employees for the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purposes.



APPENDICES



APPENDIX 1

T4 FLOOD MODEL – TECHNICAL MEMO

TECHNICAL MEMORANDUM - DRAFT

<i>To</i>	MACC Ltd
<i>From</i>	Mike Chapman and Rodrigo Jacas – Te Miro Water
<i>Reviewed</i>	Mike Chapman
<i>Date</i>	21/07/2023
<i>Subject</i>	T4 Flood Model

BACKGROUND

Te Miro Water were engaged by MACC Ltd to update and expand the current flood model for Te Awamutu. The purpose of the model update and expansion is to broaden the model boundary to incorporate the entire T4 growth cell.

The intention is to better understand the existing flooding within T4 and further downstream to inform the stormwater solution and overall civil design.

Once the baseline model is extended and tested it will be re-built for the developed scenario to test the proposed design.

Step 1: Update the existing ICM Te Awamutu model (provided by Waipa District Council) extending the boundary to the west. The current 1D catchments are loaded into 2D point source in the model.

The catchments and hydrology parameters are shown below. The urban subcatchment are the same than in the TA ICM model.

HYDROLOGY

The rainfall depths for modelling are shown in Table 1

Rainfall:

	<u>24hr- Depths (mm)</u>
2yr RPC 6.0	75
10yr RPC 6.0	114
100yr RPC 6.0	173

The Base Model sub catchments are shown in Figure 1.

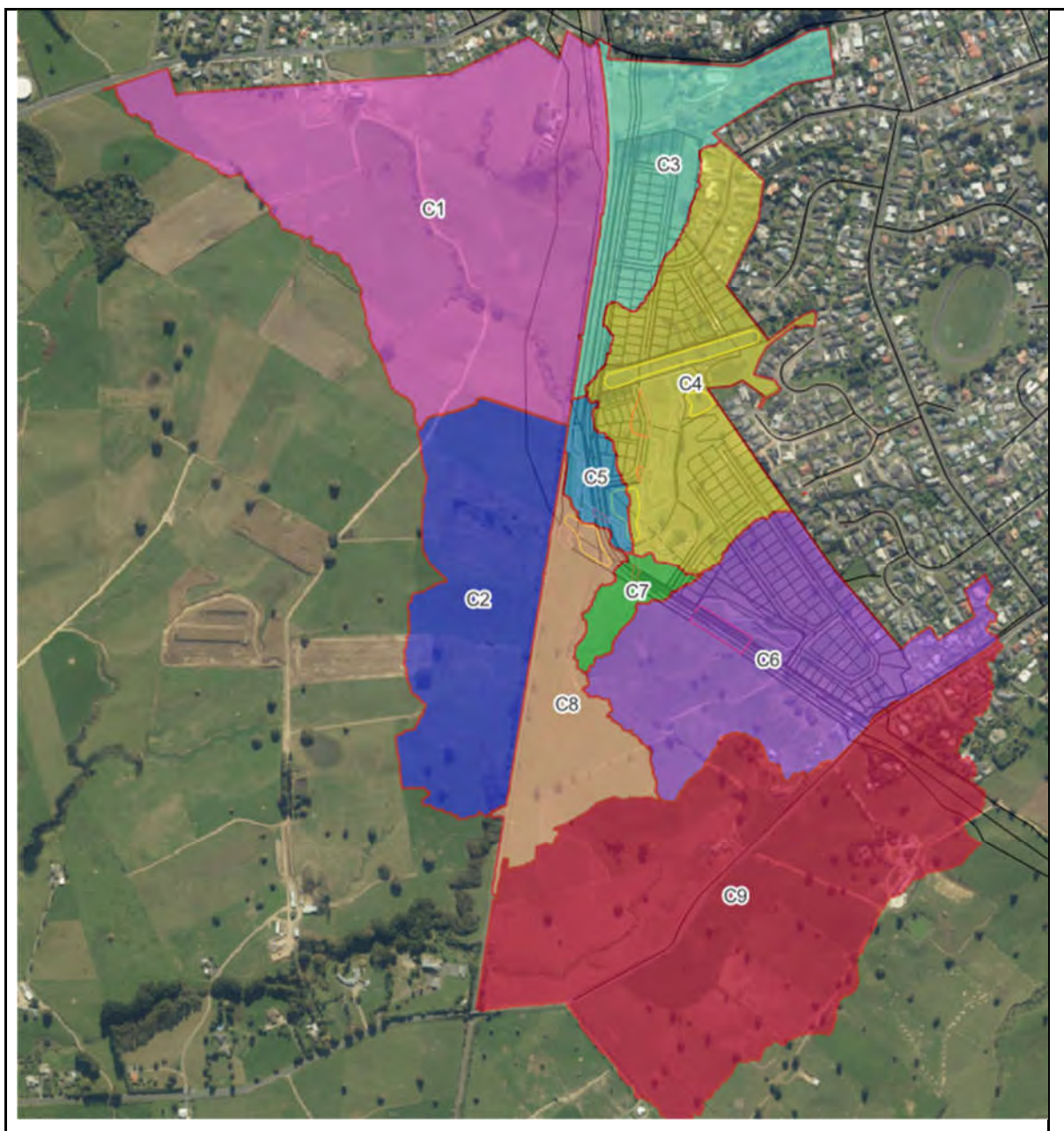


Figure 1 – T4 Existing catchments

The Developed model sub catchments are shown in Figure 2. Note sub catchments outside the growth zone remain as per existing catchment. The interior T4 sub catchment is aligned to the developed boundaries provided by Harrison Grierson.

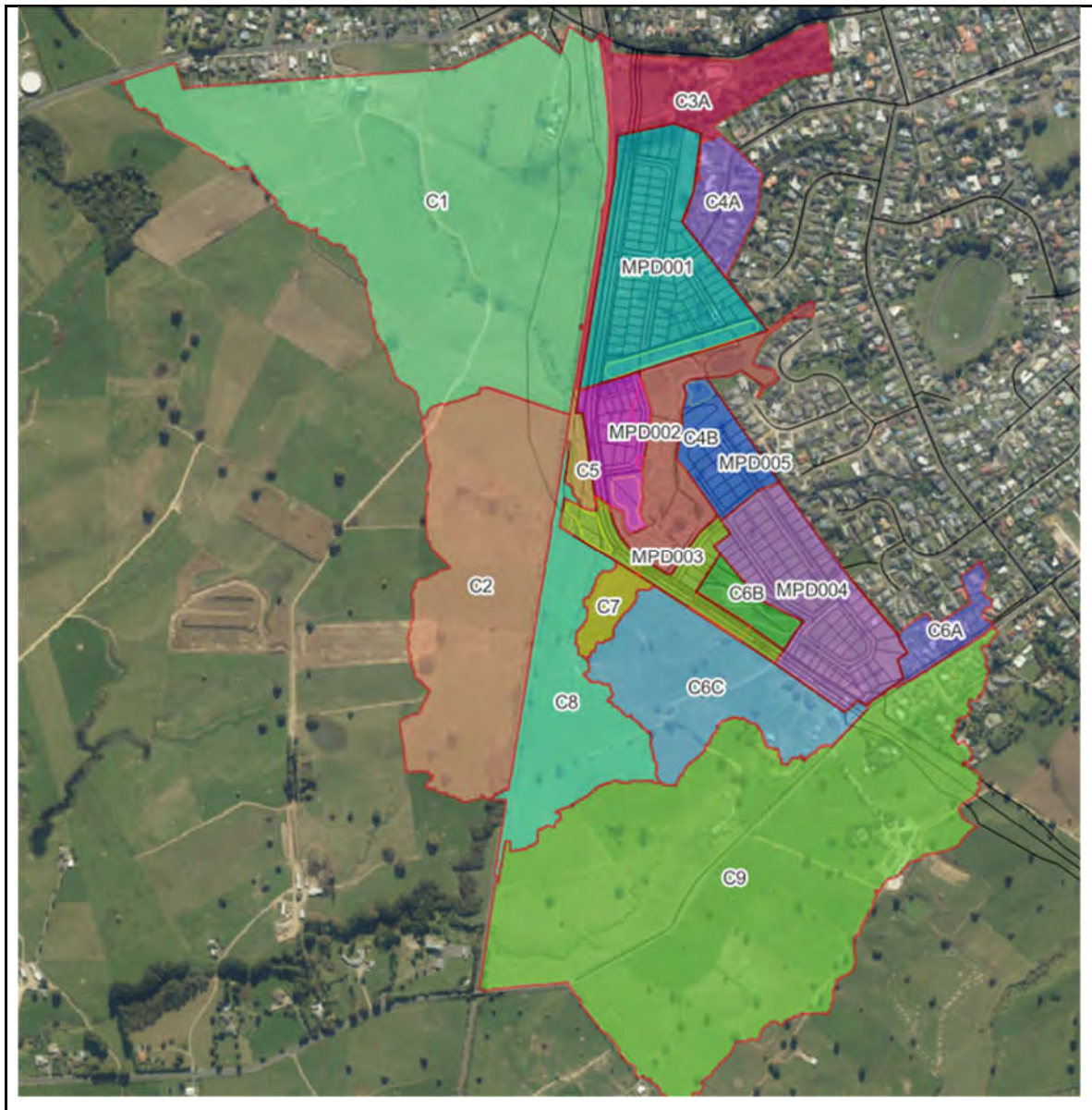


Figure 2 – T4 Developed catchments.

The sub catchment soil types and hydrological assumptions are presented in Table 2.

	<u>Area (Ha)</u>	<u>CN</u>	<u>la</u>	<u>ToC Min)</u>
C1	34.434	64.8	6.9	13.9
C2	15.883	67.8	6.0	15.5
C3A	5.208	69.0	5.7	10
C4A	2.275	58.8	8.9	10
C4B	4.344	58.8	8.9	10
C5	0.7	73.6	4.6	10
C6A	1.552	67.4	6.1	10
C6B	1.199	67.4	6.1	10
C6C	8.581	67.4	6.1	10
C7	1.101	73.0	4.7	10
C8	8.299	72.8	4.7	10
C9	39.004	68.4	5.9	21.6
MPD001	8.99	87.8	1.8	10
MPD002	2.658	88.1	1.7	10
MPD003	2.55	89.2	1.5	10
MPD004	6.906	88.7	1.6	10
MPD005	2.601	86.2	2.0	10

HYDRAULIC MODEL ASSUMPTIONS

2 x railway culverts are from survey, however the 3rd (furthest south downstream of development is also assumed as a 900mm culvert (as per surveyed culverts). This culvert controls the large ponding area upstream and therefore should be surveyed also to confirm the impact of existing and future flooding in this location.

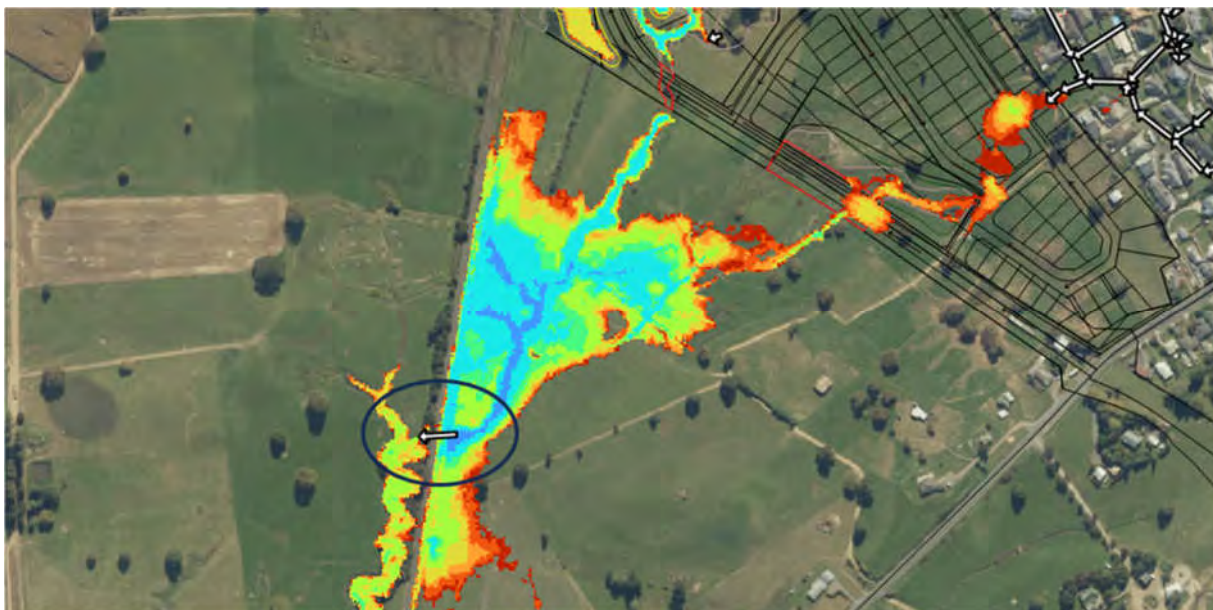


Figure 3: showing base flood model and railway culvert assumed as 900mm diameter (note extensive ponding upstream of rail line)

The MPD developed model includes dummy culverts under the proposed roads (rectangular culverts 4000x1000mm) and from the wetlands (1800mm culverts) all within T4 (Figure 4). Dummy culverts have been agreed with HG given the intention of this first model run is to test whether a 'pass it forward' approach is suitable for this area. In other words, to not undertake flood attenuation and peak flow control to existing levels on site.

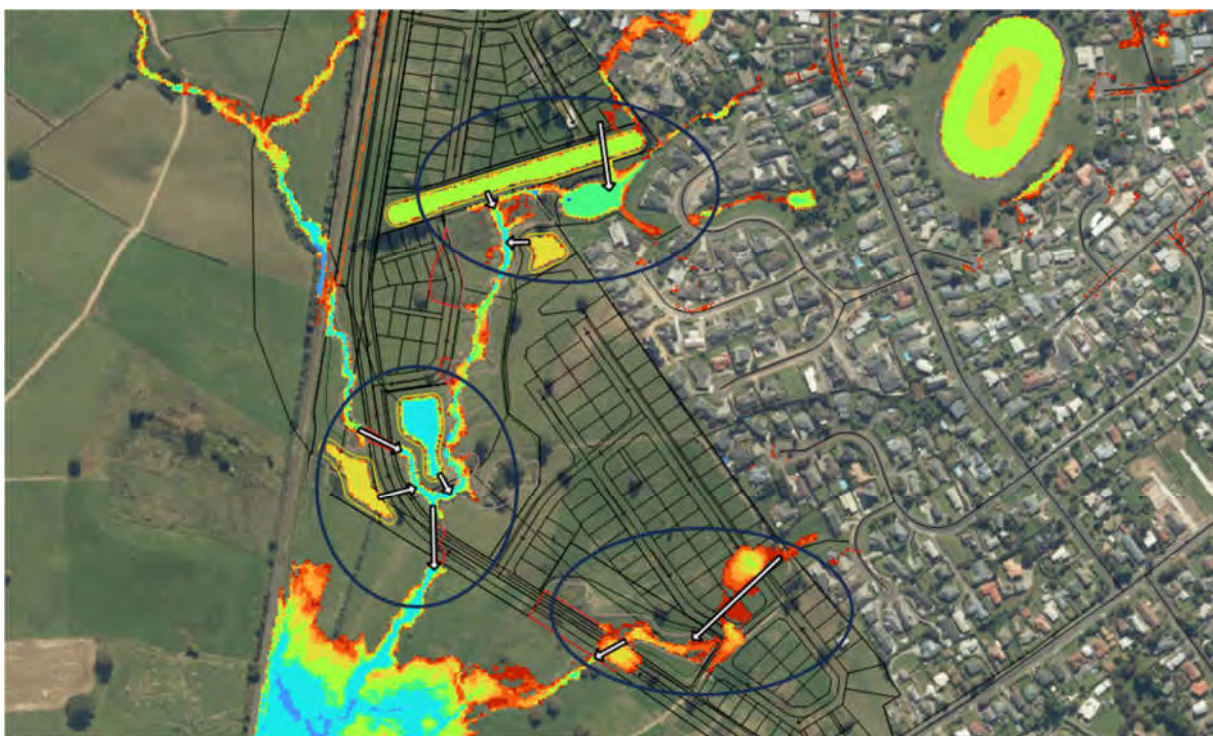


Figure 4: Dummy pipes (white) under proposed roads and linking proposed wetlands. Culverts oversized to ensure no throttle impacts ie. Pass on unattenuated MPD runoff to the downstream receiving environment for the 2yr, 10yr and 100yr + cc events.

The urban subcatchment have been maintained from the Te Awamutu ICM model without modifications as per Figure 5.



Figure 5: showing existing urban sub catchments as currently sitting in the wider WDC Te Awamutu model (these remain unchanged for T4).

RESULTS

Flood maps for the base and developed 2yr, 10yr and 100yr are provided in the appendix.

Note the developed maps are based on unattended flows through the site with dummy culverts and pipes to convey those MPD flows. The wetlands based on levels are provided by MACC and I understand these wetlands are currently sized for water quality treatment only.

Depth comparison maps show the difference between base and developed flood extend within the ponding area downstream. Initial model results indicate depths increases of up to 20mm for the developed scenario. Some shallow overland flow paths ~100mm are activated downstream for the developed scenario.

CONCLUSIONS

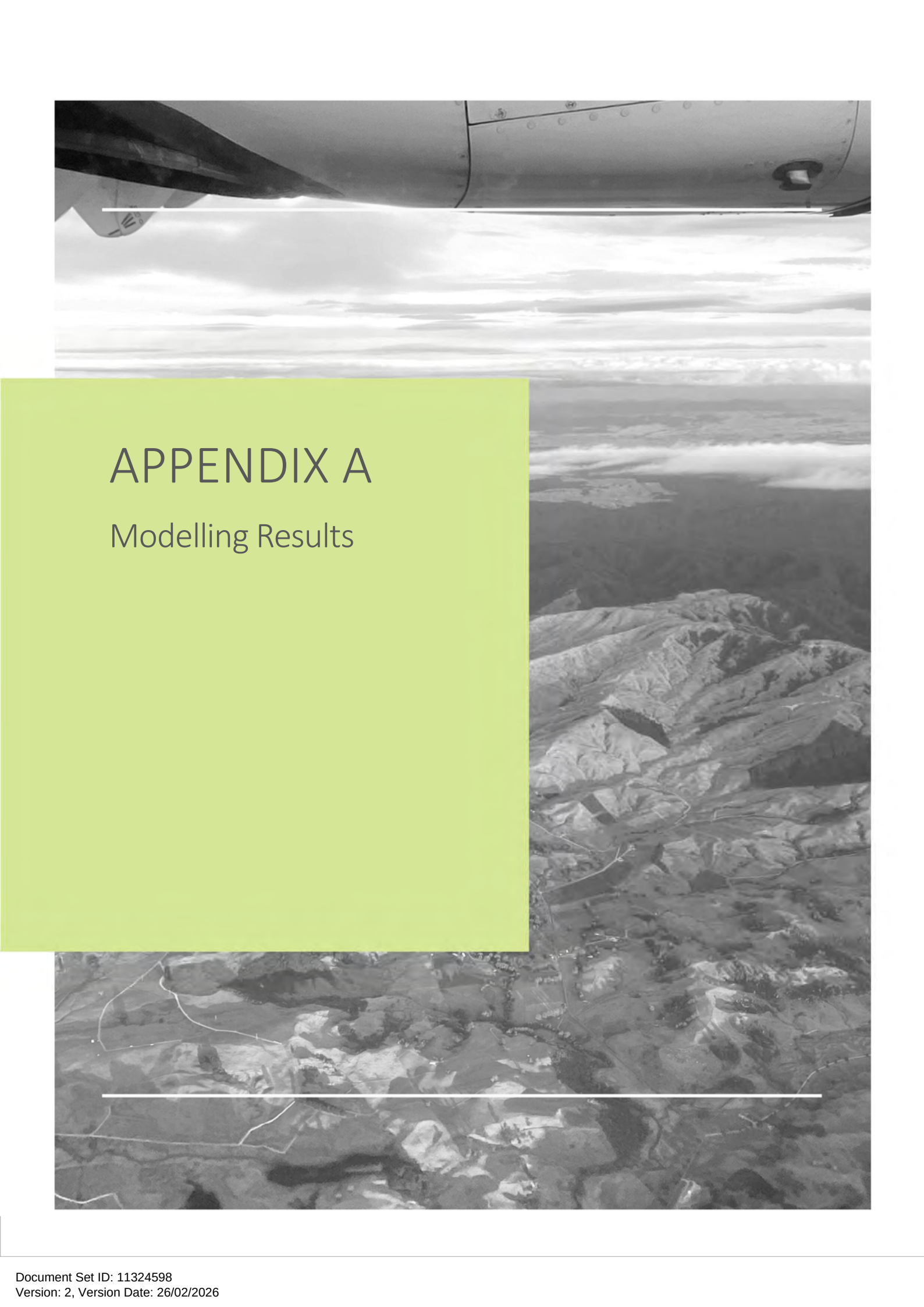
- 1.
- 2
- 3

RECOMMENDATIONS

1. Assess flood risk downstream to confirm whether there's a need to undertake flood attenuation on stie within T4 in addition to treatment wetlands.
2. Confirm railway culvert sizing by survey.
3. Test MPD future design iterations once flood risk mitigations are confirmed as to need or not.

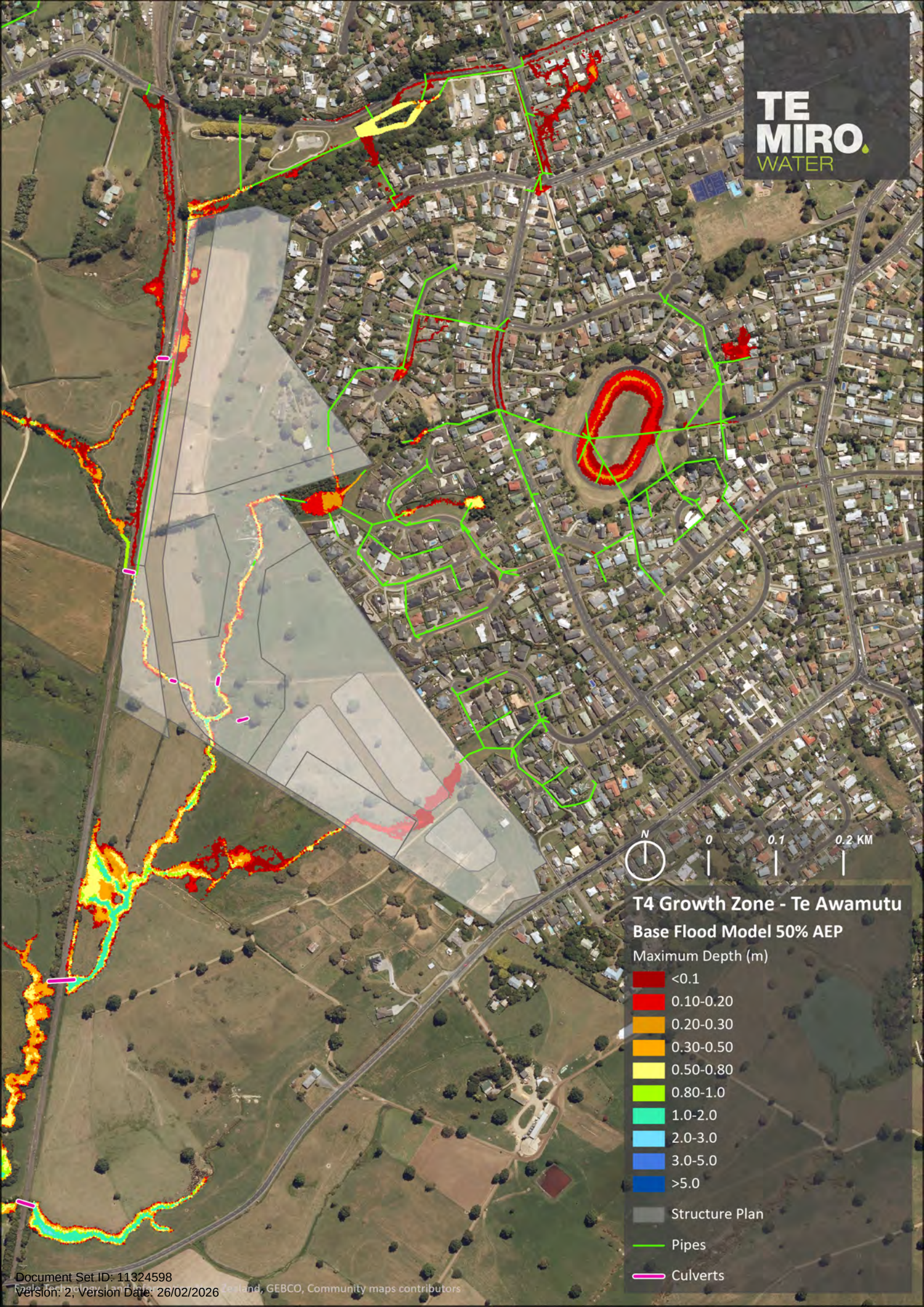
LIMITATIONS

This report has been prepared for MACC Ltd. No responsibility is accepted by Te Miro Water Limited, or its directors, servants, agents, staff, employees, or subcontractors related to the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purpose.

A black and white aerial photograph of a mountain range. The top of the image shows the underside of an aircraft wing. Below the wing, there are layers of clouds. The middle and bottom sections of the image show a detailed view of a mountain range with various ridges and valleys. A large green rectangular box is overlaid on the left side of the image, containing the title text.

APPENDIX A

Modelling Results



0

0.1

0.2 KM

T4 Growth Zone - Te Awamutu

Base Flood Model 50% AEP

Maximum Depth (m)



Structure Plan

Pipes

Culverts



T4 Growth Zone - Te Awamutu

Base Flood Model 10% AEP

Maximum Depth (m)



Structure Plan

Pipes

Culverts



T4 Growth Zone - Te Awamutu

Base Flood Model 1% AEP

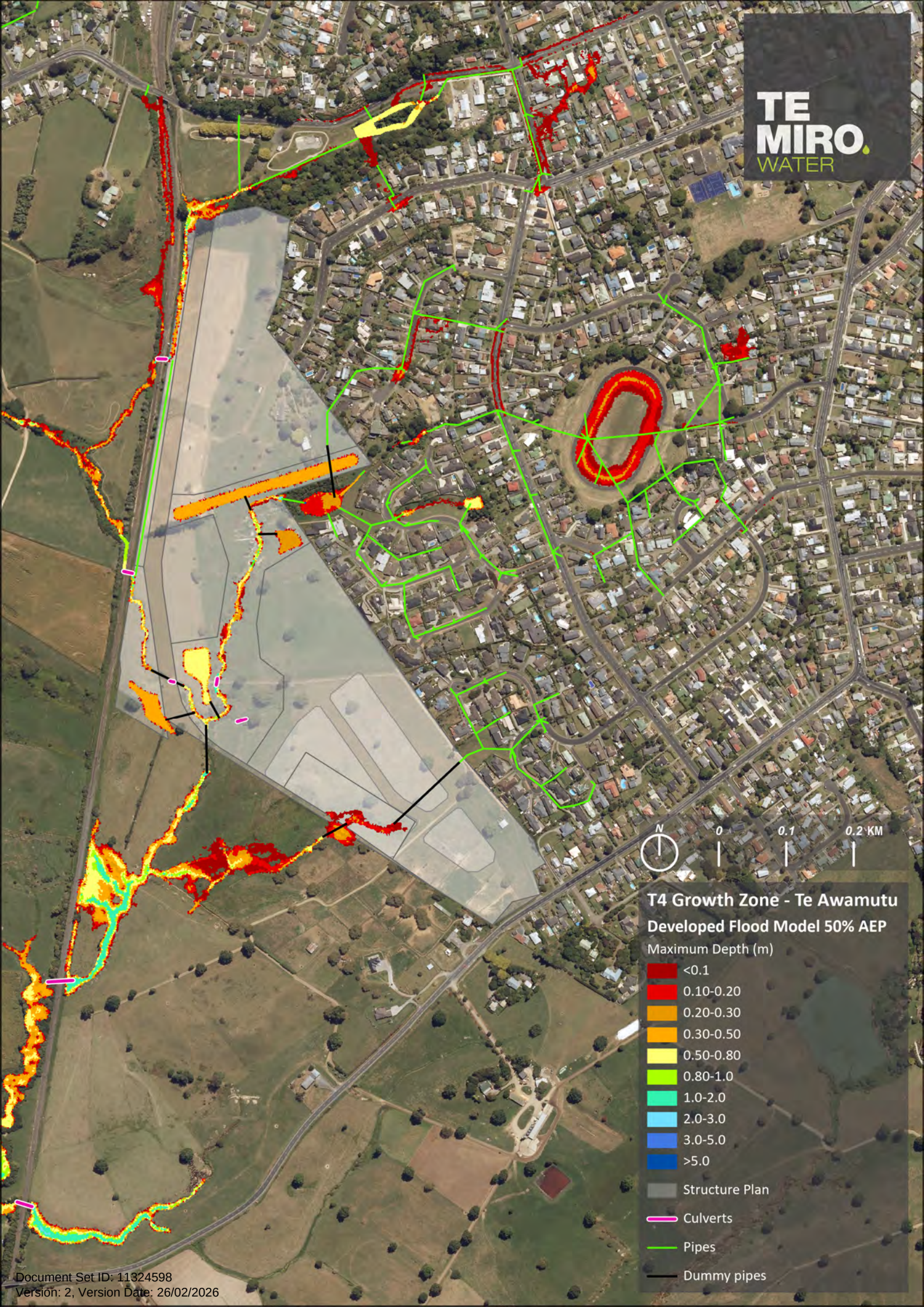
Maximum Depth (m)



Structure Plan

Pipes

Culverts



T4 Growth Zone - Te Awamutu
Developed Flood Model 50% AEP

Maximum Depth (m)



Structure Plan

Culverts

Pipes

Dummy pipes



T4 Growth Zone - Te Awamutu
Developed Flood Model 10% AEP

Maximum Depth (m)

- <0.1
- 0.10-0.20
- 0.20-0.30
- 0.30-0.50
- 0.50-0.80
- 0.80-1.0
- 1.0-2.0
- 2.0-3.0
- 3.0-5.0
- >5.0

Structure Plan

Culverts

Pipes

Dummy pipes



T4 Growth Zone - Te Awamutu
Developed Flood Model 1% AEP

Maximum Depth (m)

- <0.1
- 0.10-0.20
- 0.20-0.30
- 0.30-0.50
- 0.50-0.80
- 0.80-1.0
- 1.0-2.0
- 2.0-3.0
- 3.0-5.0
- >5.0

Structure Plan

Culverts

Pipes

Dummy pipes



T4 Growth Zone - Te Awamutu
2 Year Comparative (MPD-ED)

Depth (m)



New Ponding Areas

Previous Ponding Areas

Structure Plan



T4 Growth Zone - Te Awamutu
10 Year Comparative (MPD-ED)

Value



New Ponding Areas

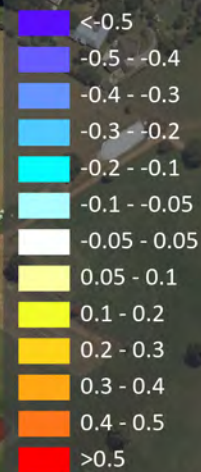
Previous Ponding Areas

Structure Plan



T4 Growth Zone - Te Awamutu
100 Year Comparative (MPD-ED)

Depth (m)



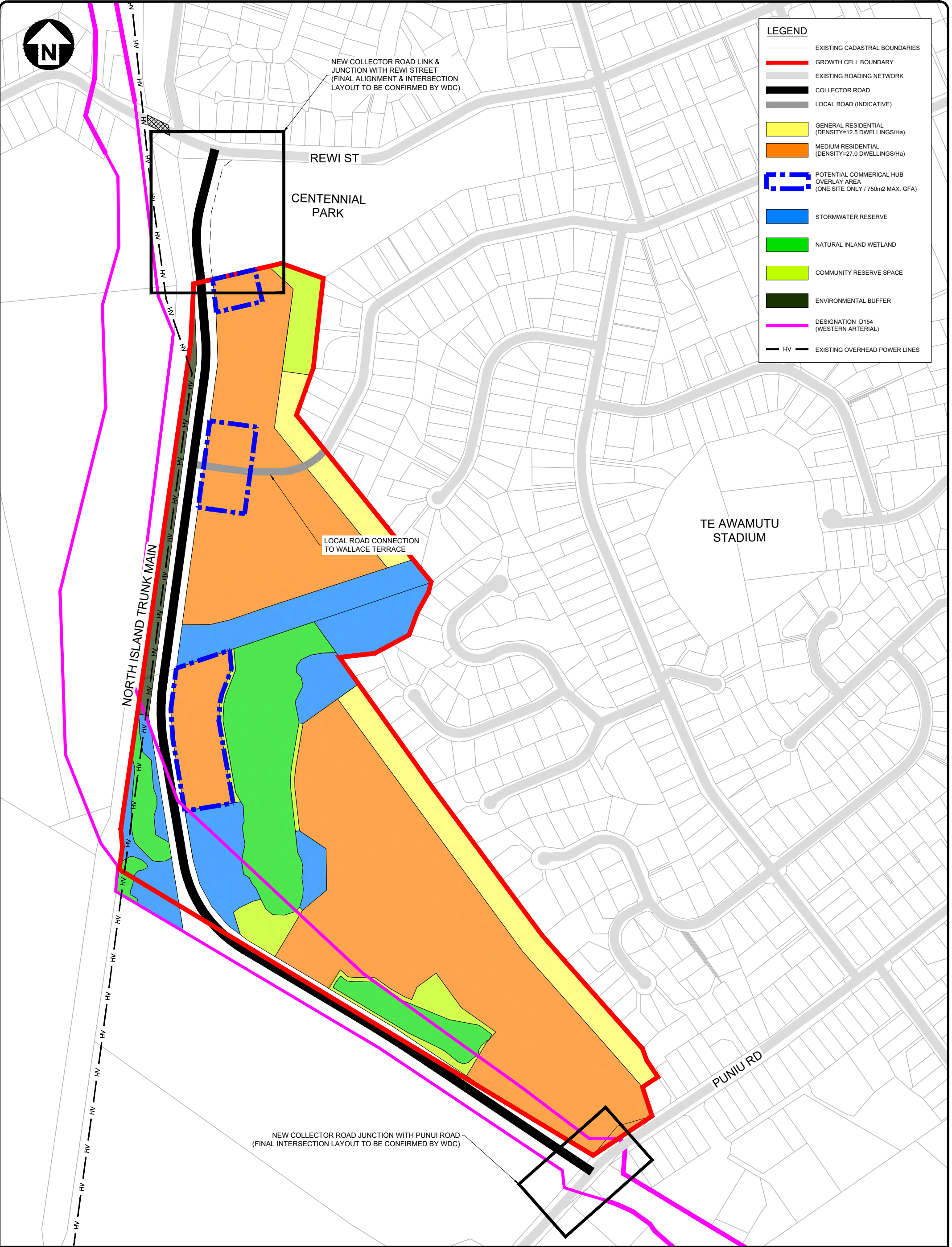
New Ponding Areas

Previous Ponding Areas

Structure Plan

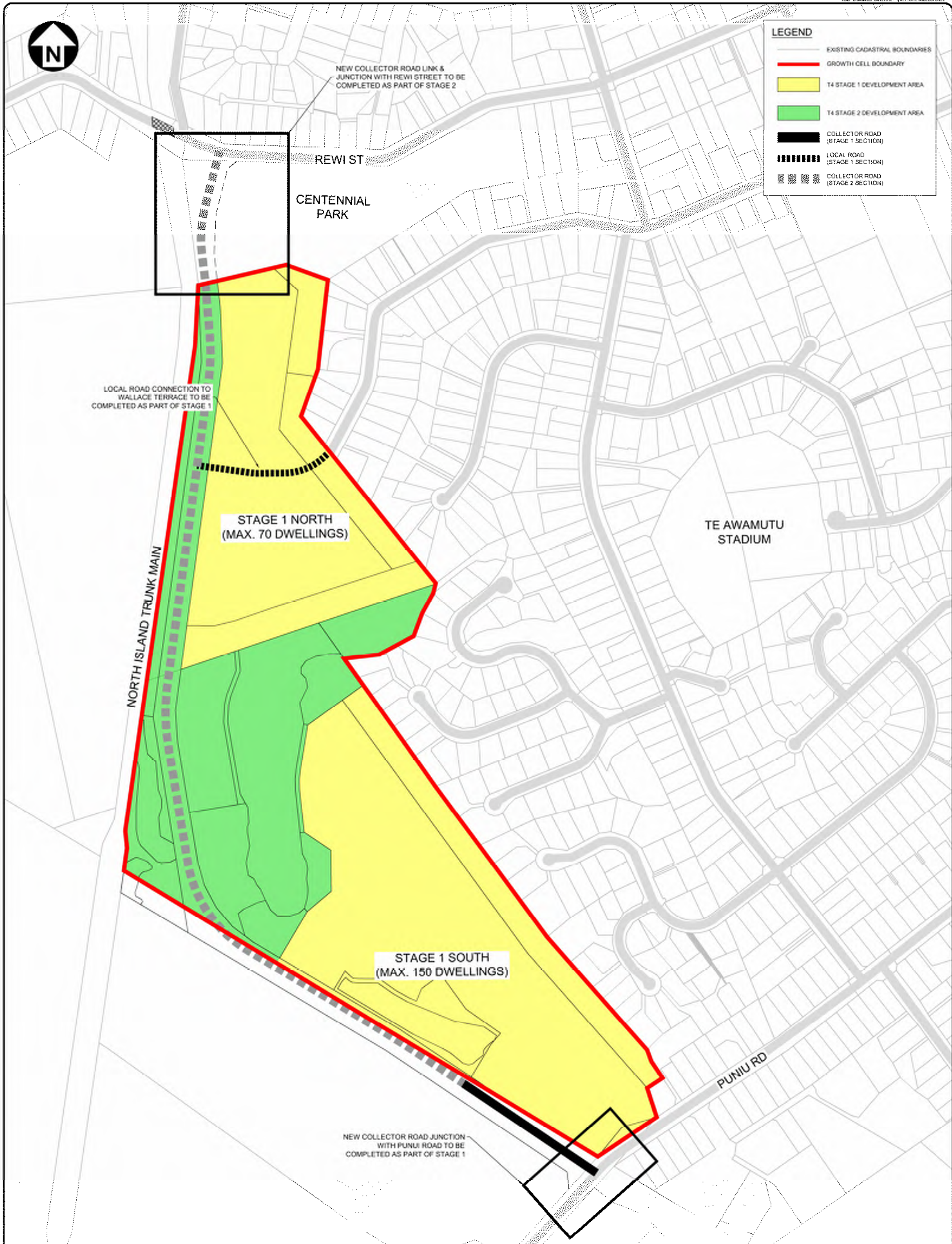
APPENDIX 2

T4 PROPOSED STRUCTURE PLAN DRAWINGS



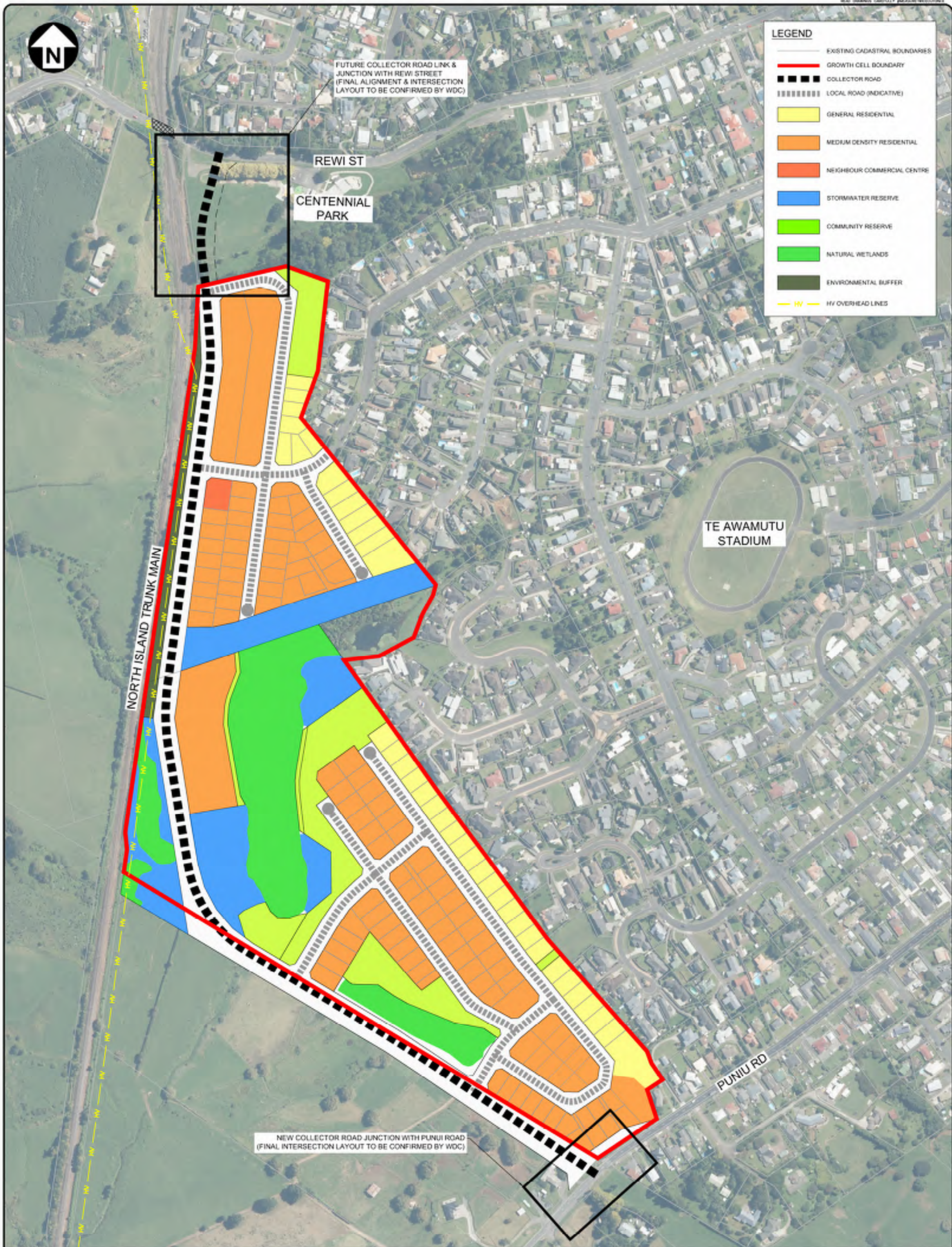
**PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU**

**PROPOSED
STRUCTURE PLAN**



PROPOSED PLAN CHANGE T4 GROWTH CELL TE AWAMUTU

INDICATIVE STAGING



**PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU**

**SUBDIVISION CONCEPT
INDICATIVE LAYOUT**

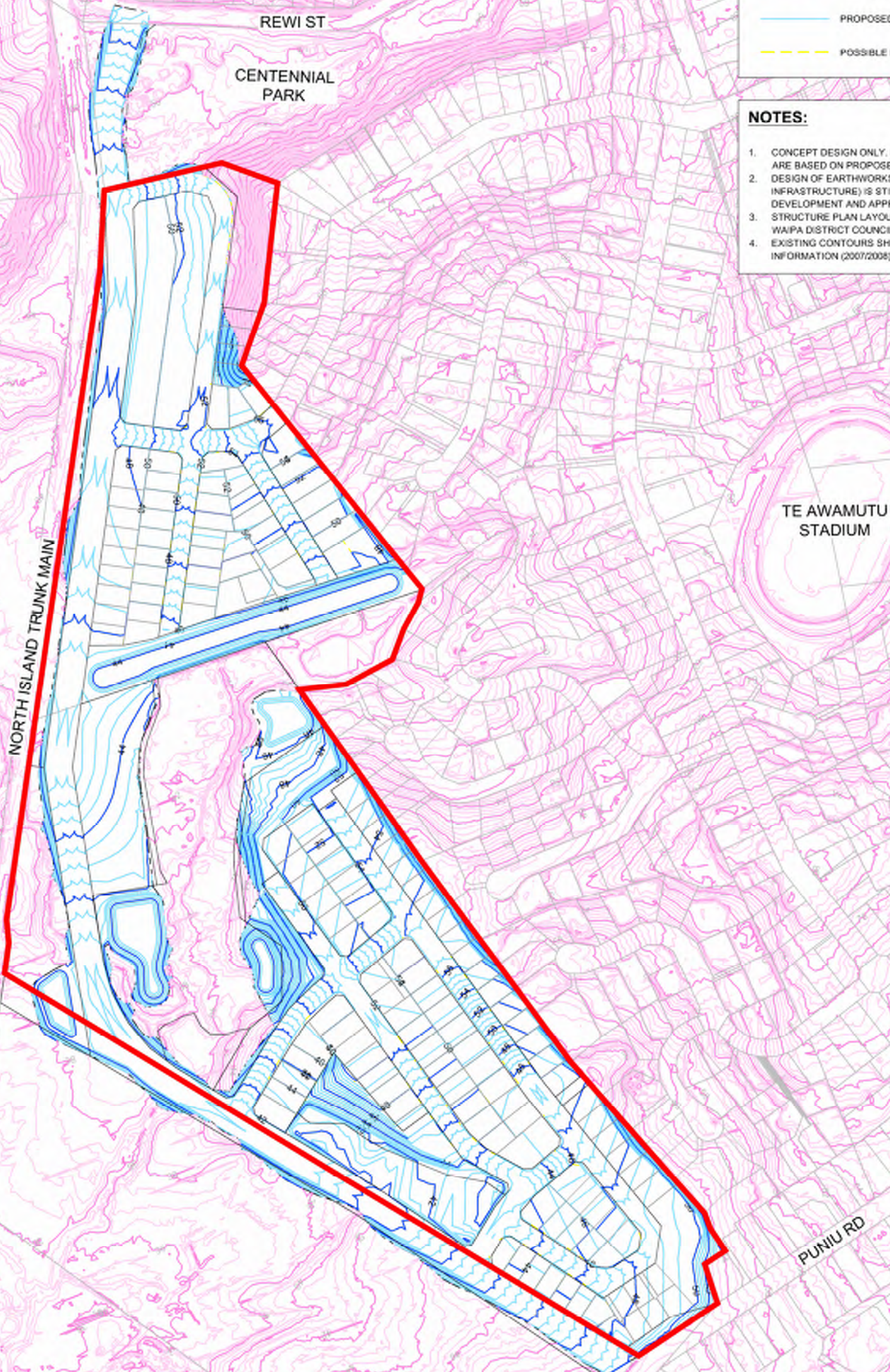


LEGEND

- GROWTH CELL BOUNDARY
- 43 EXISTING CONTOUR (2.0m INTERVAL)
- EXISTING CONTOUR (0.5m INTERVAL)
- 45 PROPOSED DESIGN CONTOUR (2.0m INTERVAL)
- PROPOSED DESIGN CONTOUR (0.5m INTERVAL)
- POSSIBLE RETAINING STRUCTURE

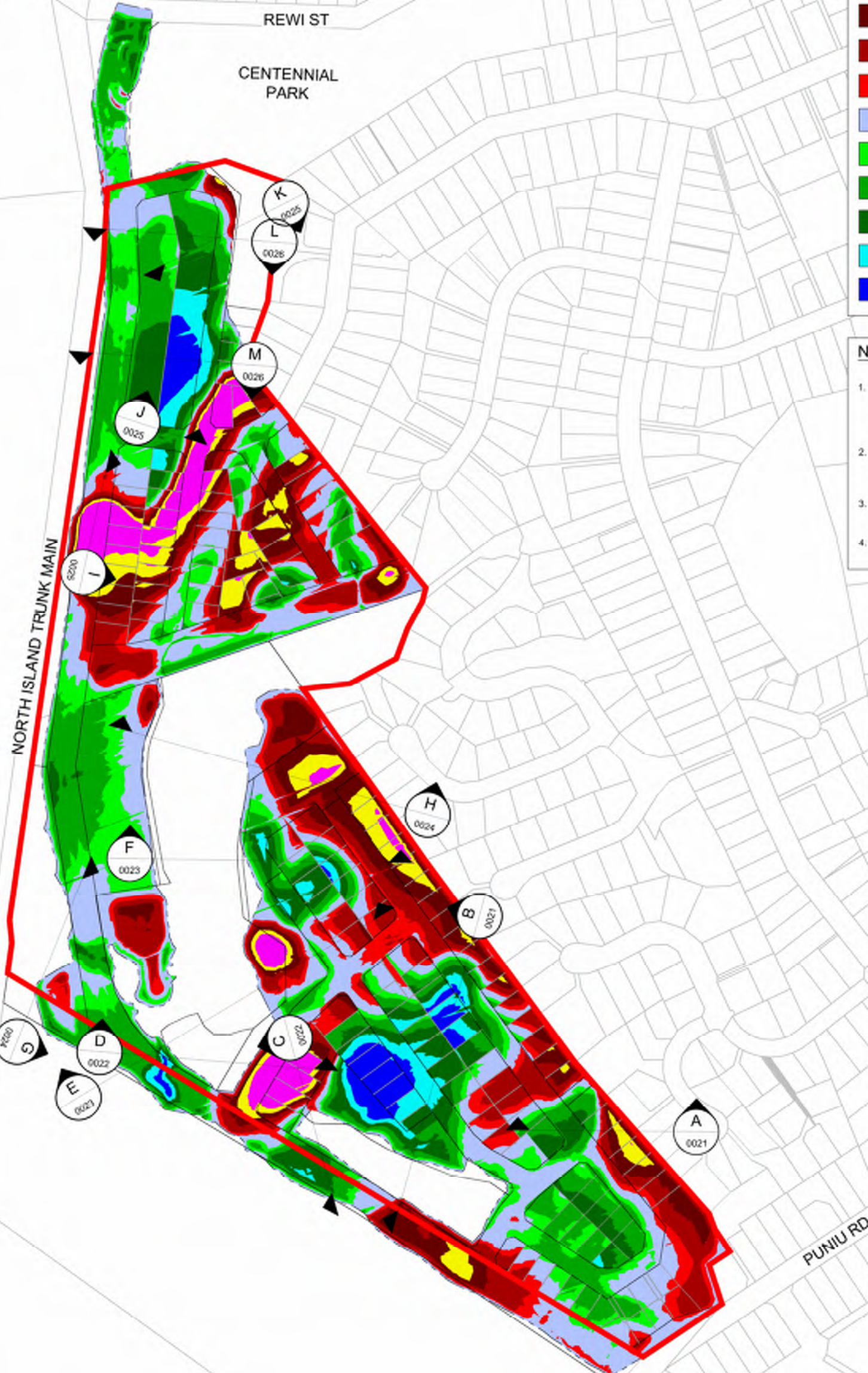
NOTES:

1. CONCEPT DESIGN ONLY. EARTHWORKS CONTOURS SHOWN ARE BASED ON PROPOSED DESIGN SURFACE LEVELS
2. DESIGN OF EARTHWORKS (AND ASSOCIATED INFRASTRUCTURE) IS STILL SUBJECT TO FURTHER DESIGN DEVELOPMENT AND APPROVAL BY RELEVANT AUTHORITIES
3. STRUCTURE PLAN LAYOUT IS SUBJECT TO CONFIRMATION BY WAIKATO DISTRICT COUNCIL
4. EXISTING CONTOURS SHOWN ARE BASED ON WRC LIDAR INFORMATION (2007/2008)



**PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU**

**EARTHWORKS
INDICATIVE LEVELS**



LEGEND

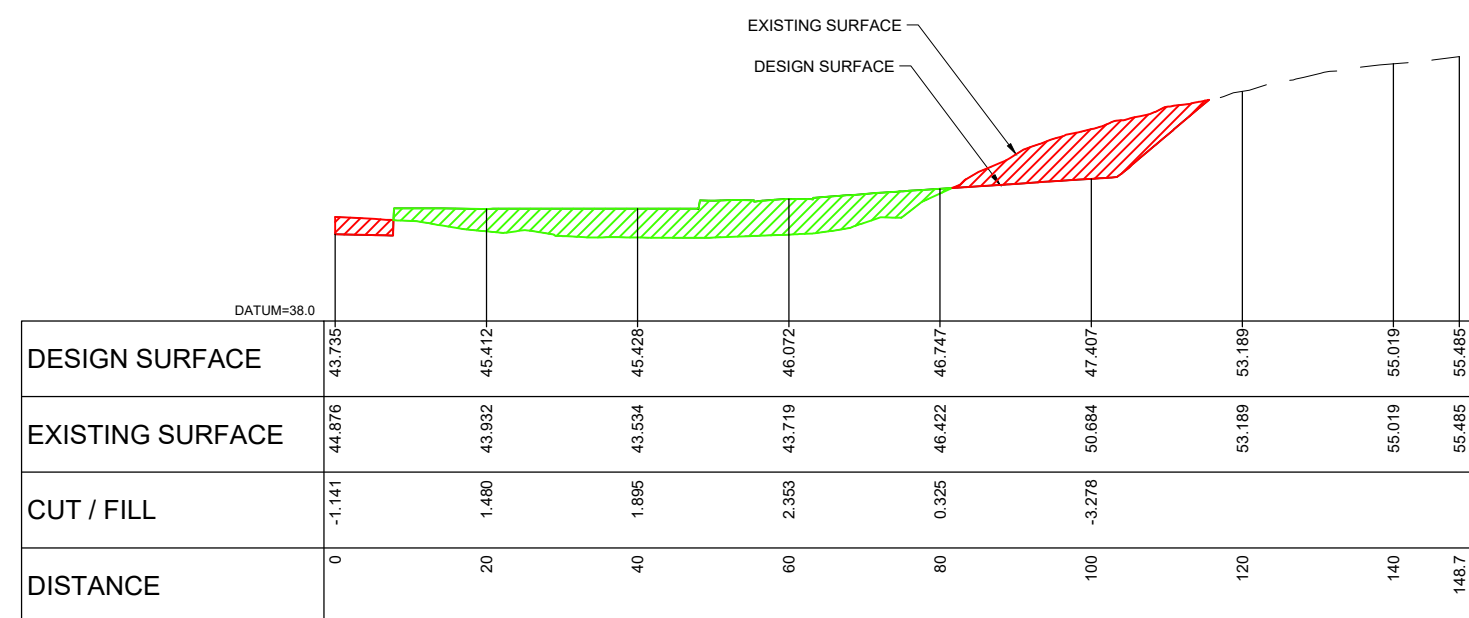
—	GROWTH CELL BOUNDARY
EARTHWORKS (CUT/FILL AREAS)	
	> 4m CUT
	3.0m TO 4.0m CUT
	2.0m TO 3.0m CUT
	1.0m TO 2.0m CUT
	0.5m TO 1.0m CUT
	SITE CONTOURING (±0.5m)
	0.5m TO 1.0m FILL
	1.0m TO 2.0m FILL
	2.0m TO 3.0m FILL
	3.0m TO 4.0m FILL
	> 4.0m FILL

NOTES:

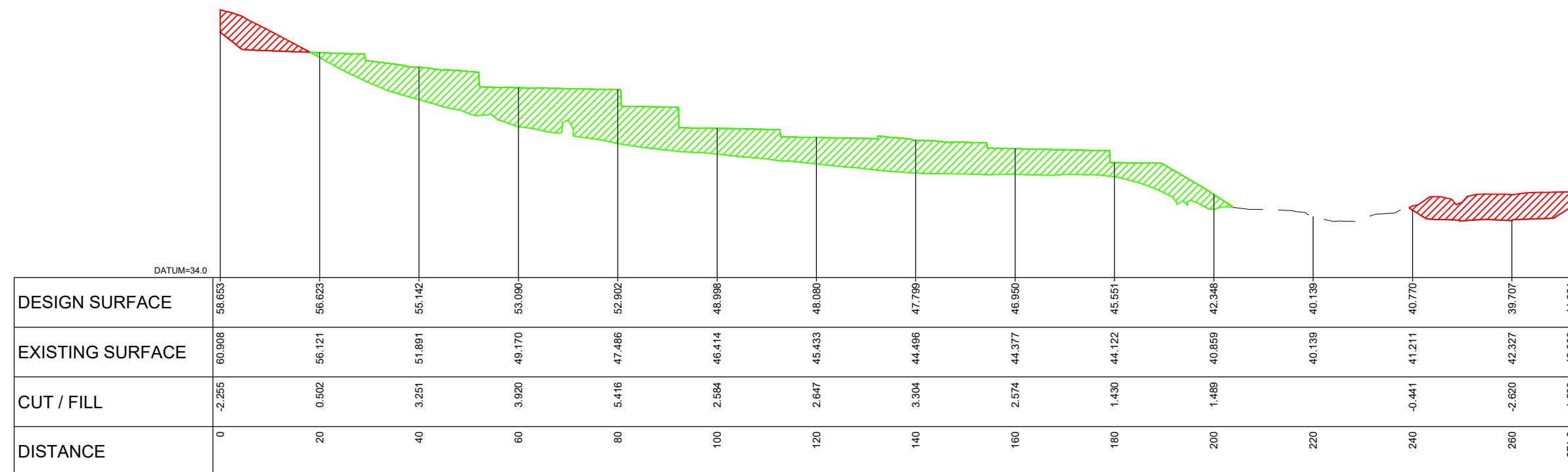
1. CUT/FILL DIAGRAM SHOWN IS INDICATIVE AND BASED ON AND INITIAL CONCEPT DEVELOPMENT FOR COMPARISON PURPOSES. FINAL EARTHWORKS IS SUBJECT TO FURTHER DESIGN.
2. CUT/FILL AREAS SHOWN ARE BASED ON SURFACE TO SURFACE LEVELS WITH NO ALLOWANCE FOR VOLUMETRIC ADJUSTMENTS OF ANY KIND.
3. THE FINAL MASTER PLAN LAYOUT IS SUBJECT TO CONFIRMATION BY WAIPA DISTRICT COUNCIL.
4. EXISTING LEVELS USED ARE BASED ON WRC LIDAR INFORMATION (2007/2008).

**PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU**

**EARTHWORKS
INDICATIVE CUT/FILL DIAGRAM**



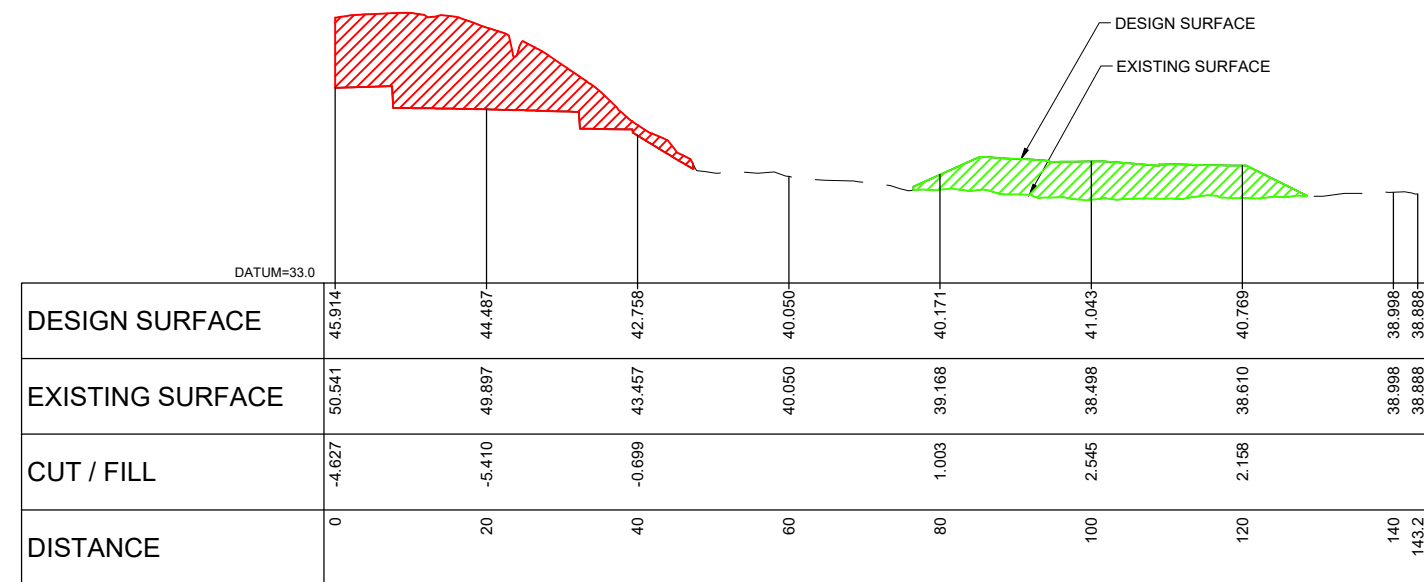
A EARTHWORKS CROSS SECTION A-A
0020 SCALE: HORIZONTAL = 1:1000 & VERTICAL = 1:500



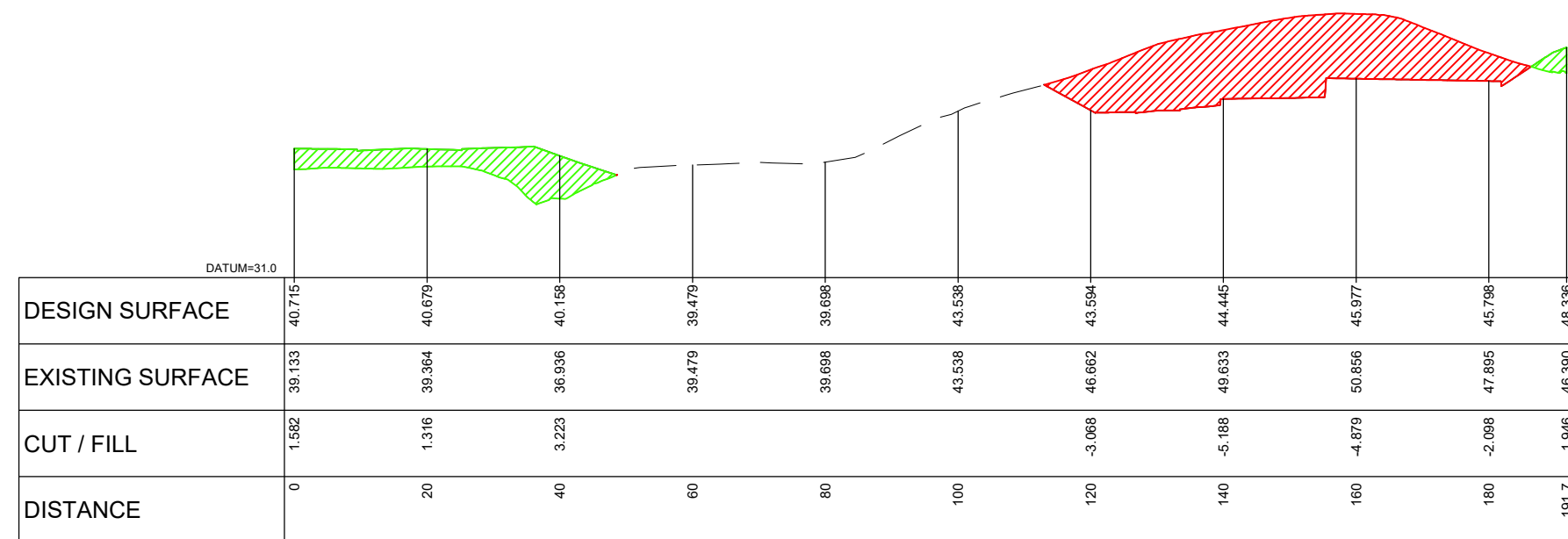
B EARTHWORKS CROSS SECTION B-B
0020 SCALE: HORIZONTAL = 1:1000 & VERTICAL = 1:500

PROPOSED PLAN CHANGE T4 GROWTH CELL TE AWAMUTU

EARTHWORKS CROSS SECTIONS SHEET 1



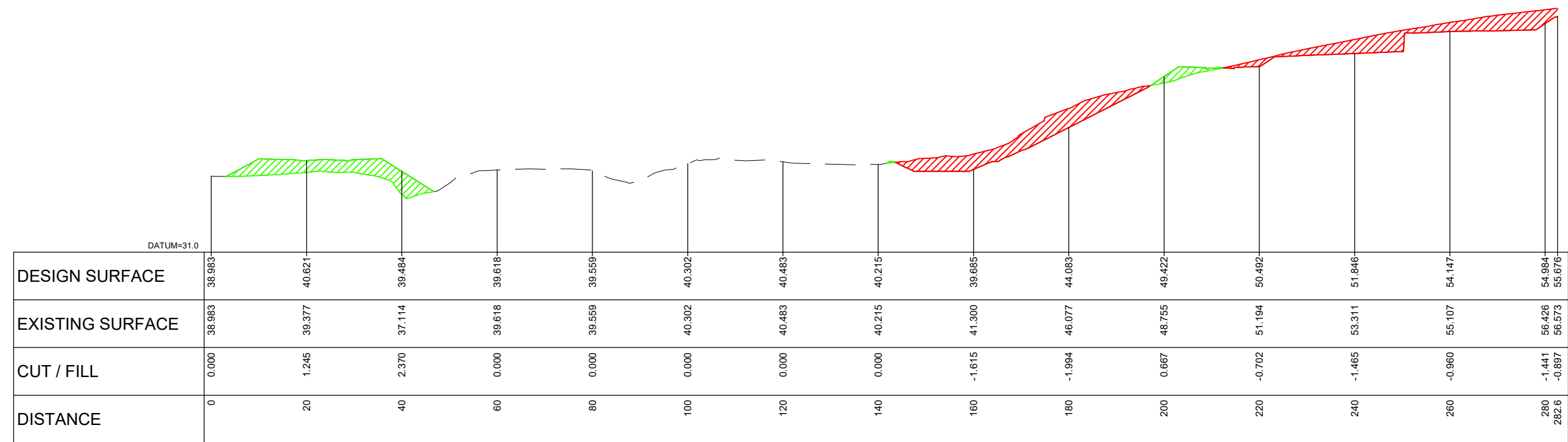
C EARTHWORKS CROSS SECTION C-C
0020 SCALE: HORIZONTAL = 1:1000 & VERTICAL = 1:500



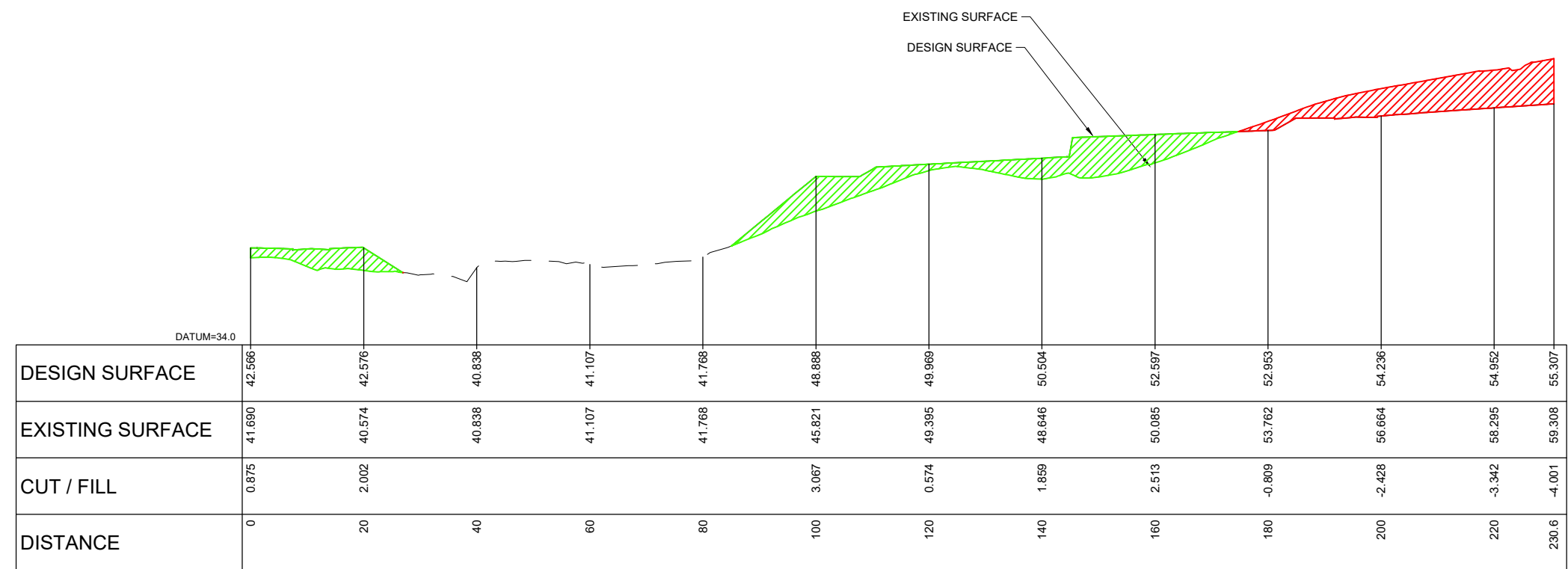
D EARTHWORKS CROSS SECTION D-D
0020 SCALE: HORIZONTAL = 1:1000 & VERTICAL = 1:500

**PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU**

**EARTHWORKS
CROSS SECTIONS
SHEET 2**



E EARTHWORKS CROSS SECTION E-E
0020 SCALE: HORIZONTAL = 1:1000 & VERTICAL = 1:500

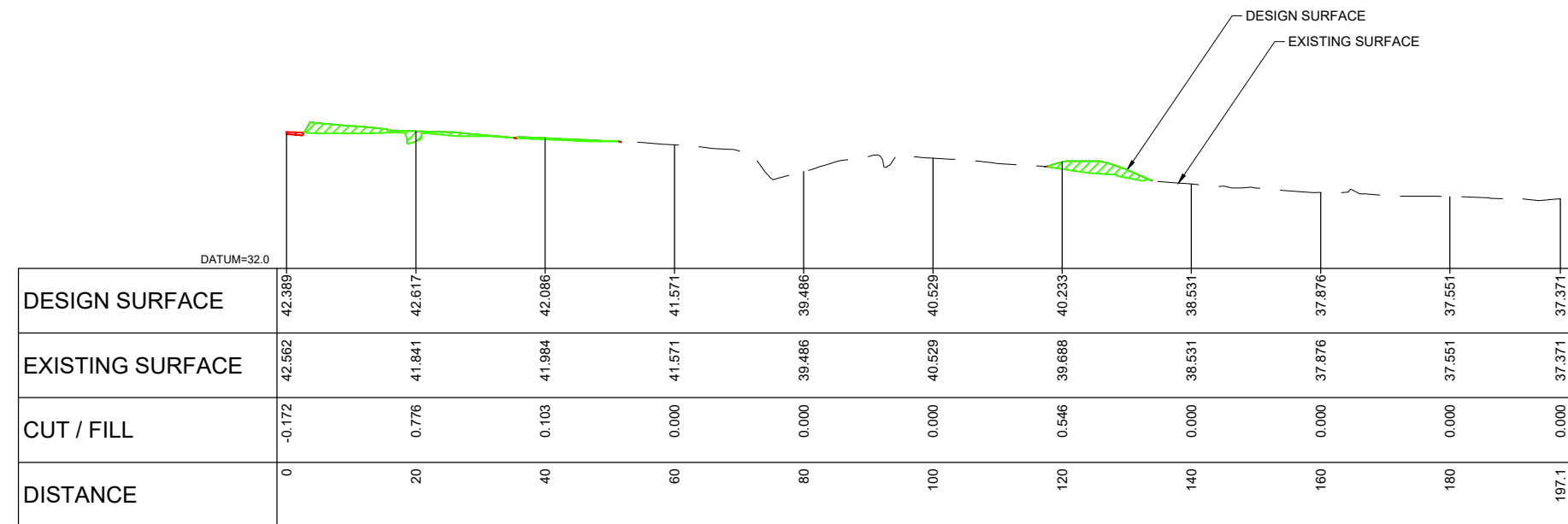


F EARTHWORKS CROSS SECTION F-F
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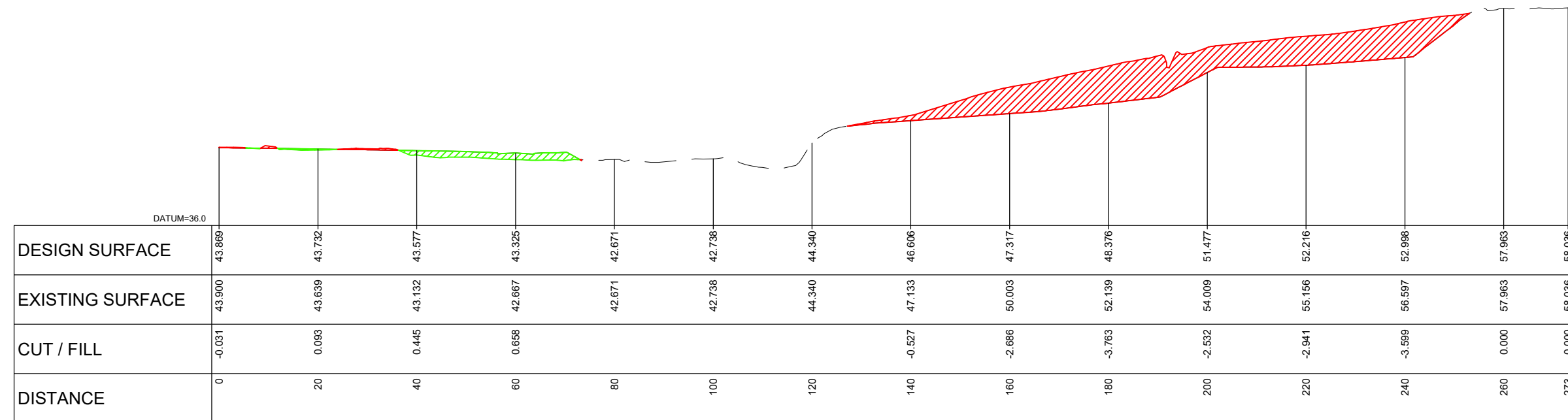
PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU

EARTHWORKS
CROSS SECTIONS
SHEET 3

DRAWING REVISION: 0



G EARTHWORKS CROSS SECTION G-G
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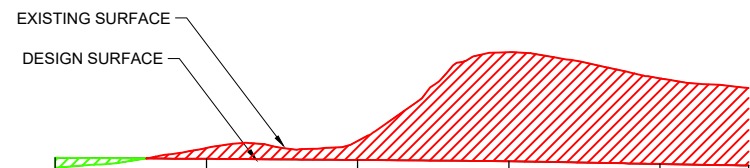


H EARTHWORKS CROSS SECTION H-H
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PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU

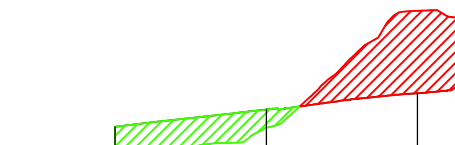
EARTHWORKS
CROSS SECTIONS
SHEET 4

DRAWING REVISION: 0



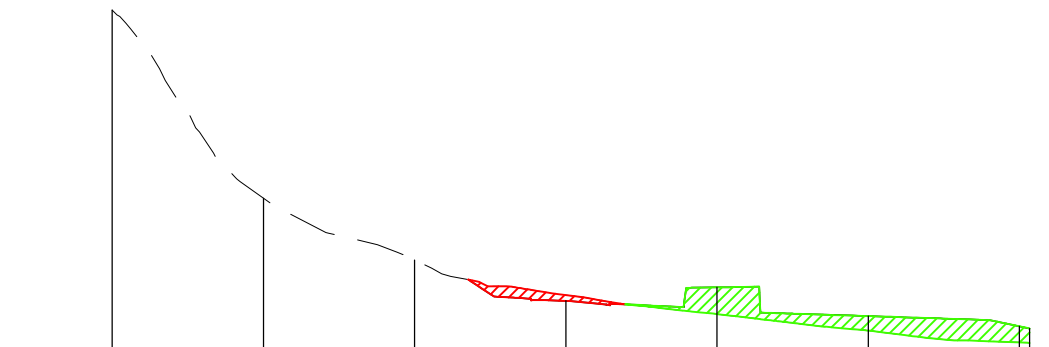
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EXISTING SURFACE	46.914	48.210	48.673	54.547	52.820	52.178
CUT / FILL	0.655	-0.716	-1.255	-7.216	-5.663	-5.124
DISTANCE	0	20	40	60	80	91.7

I EARTHWORKS CROSS SECTION I-I
0020 SCALE; HORIZONTAL = 1:1000 & VERTICAL = 1:500



	DATUM=43.0			
DESIGN SURFACE	50.100	51.226	52.307	52.645
EXISTING SURFACE	48.019	50.030	57.765	57.307
CUT / FILL	2.082	1.196	-5.458	-4.662
DISTANCE	0	20	40	45.1

J EARTHWORKS CROSS SECTION J-J
0020 SCALE; HORIZONTAL = 1:1000 & VERTICAL = 1:500

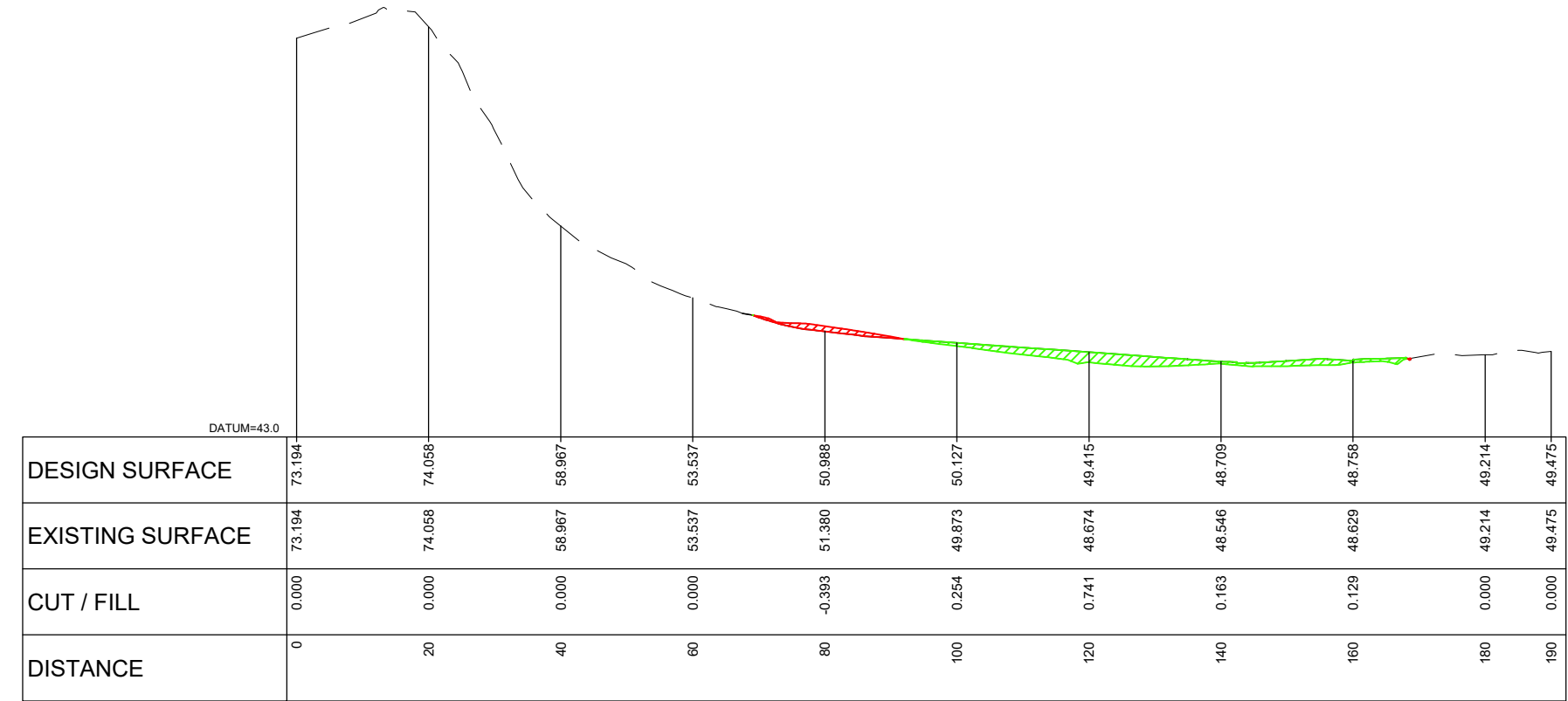


	DATUM=42.0						
DESIGN SURFACE	69.982	57.531	53.436	50.747	51.638	49.736	49.059
EXISTING SURFACE	69.982	57.531	53.436	51.125	49.872	48.781	47.994
CUT / FILL				-0.379	1.766	0.955	1.065
DISTANCE	0	20	40	60	80	100	120
							121.4

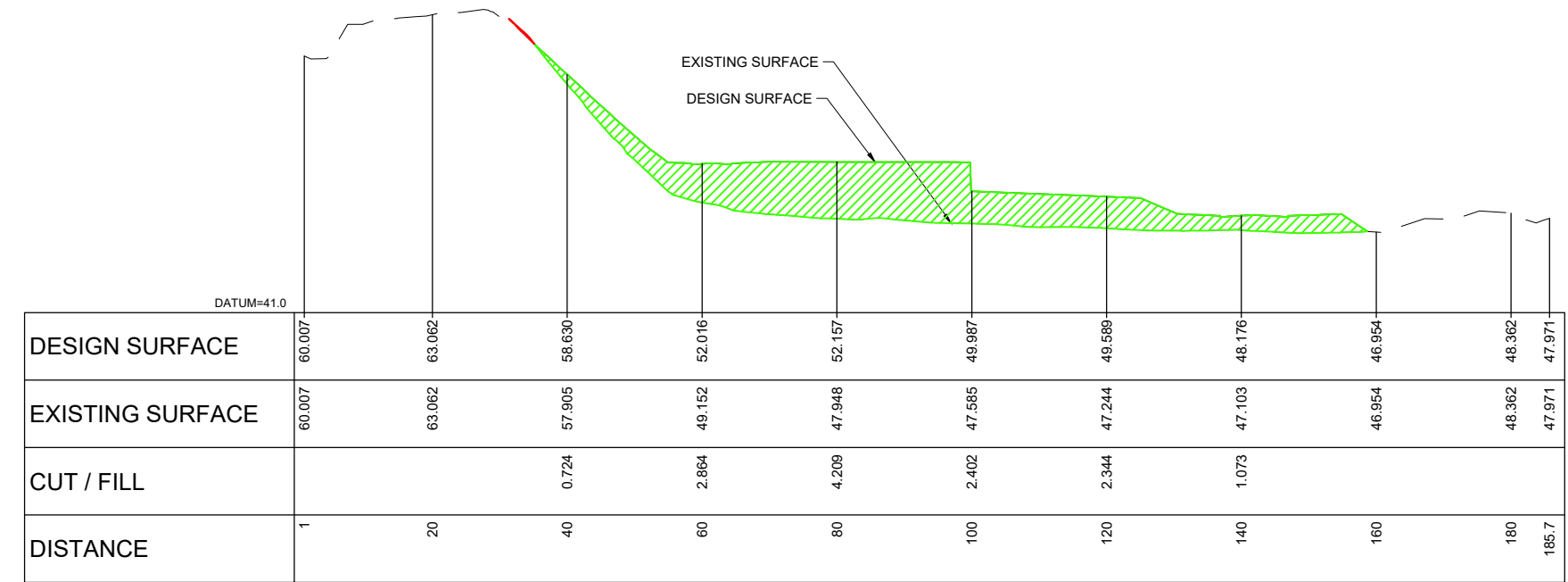
K EARTHWORKS CROSS SECTION K-K
0020 SCALE; HORIZONTAL = 1:1000 & VERTICAL = 1:500

PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU

EARTHWORKS
CROSS SECTIONS
SHEET 5



L EARTHWORKS CROSS SECTION L-L
0020 SCALE: HORIZONTAL = 1:1000 & VERTICAL = 1:500

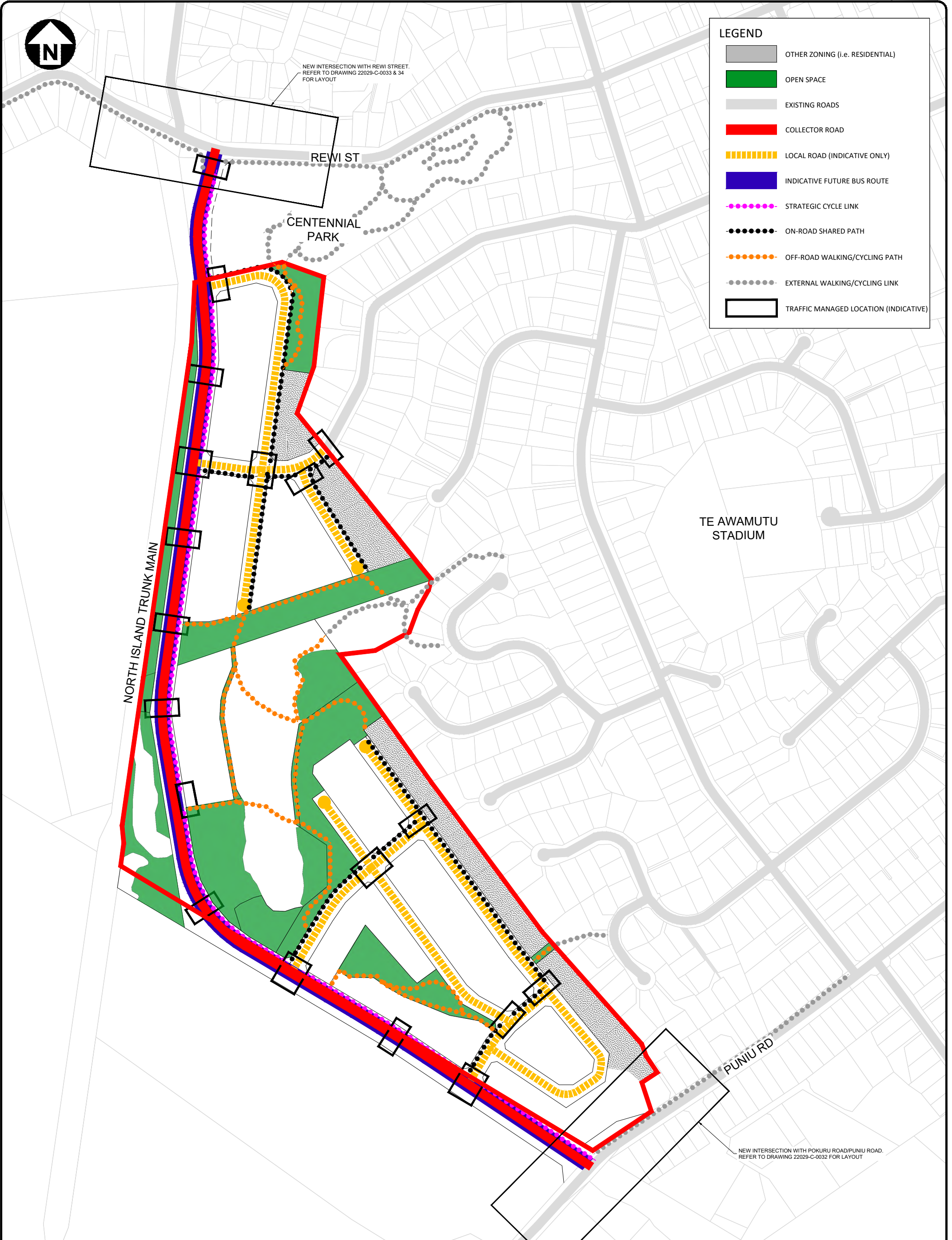


M EARTHWORKS CROSS SECTION M-M
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PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU

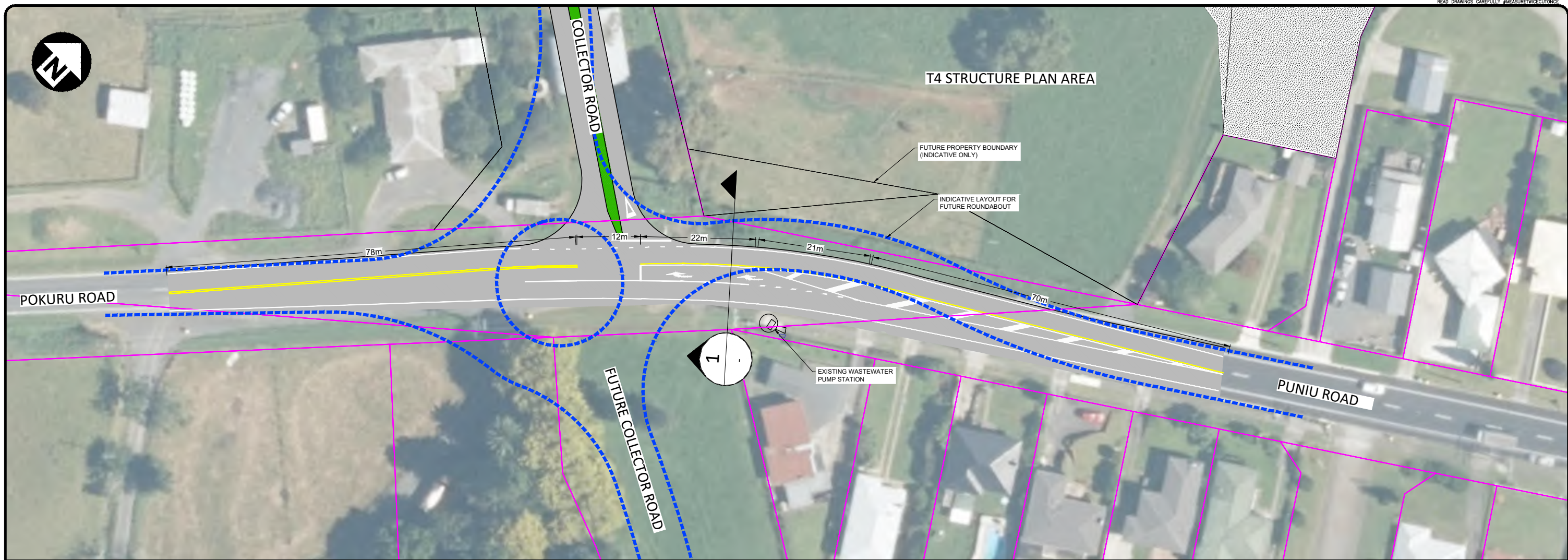
EARTHWORKS
CROSS SECTIONS
SHEET 6

DRAWING REVISION: 0



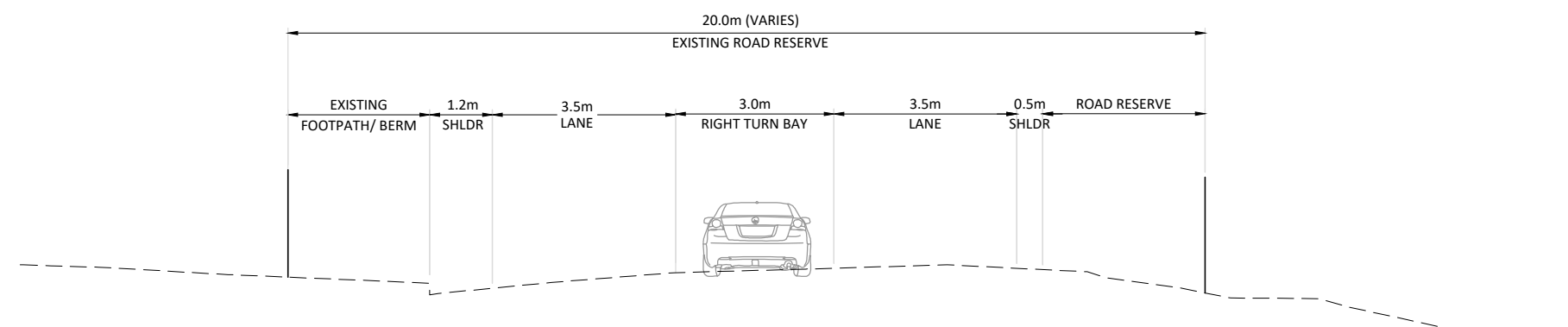
**PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU**

TRANSPORT



NOTES:

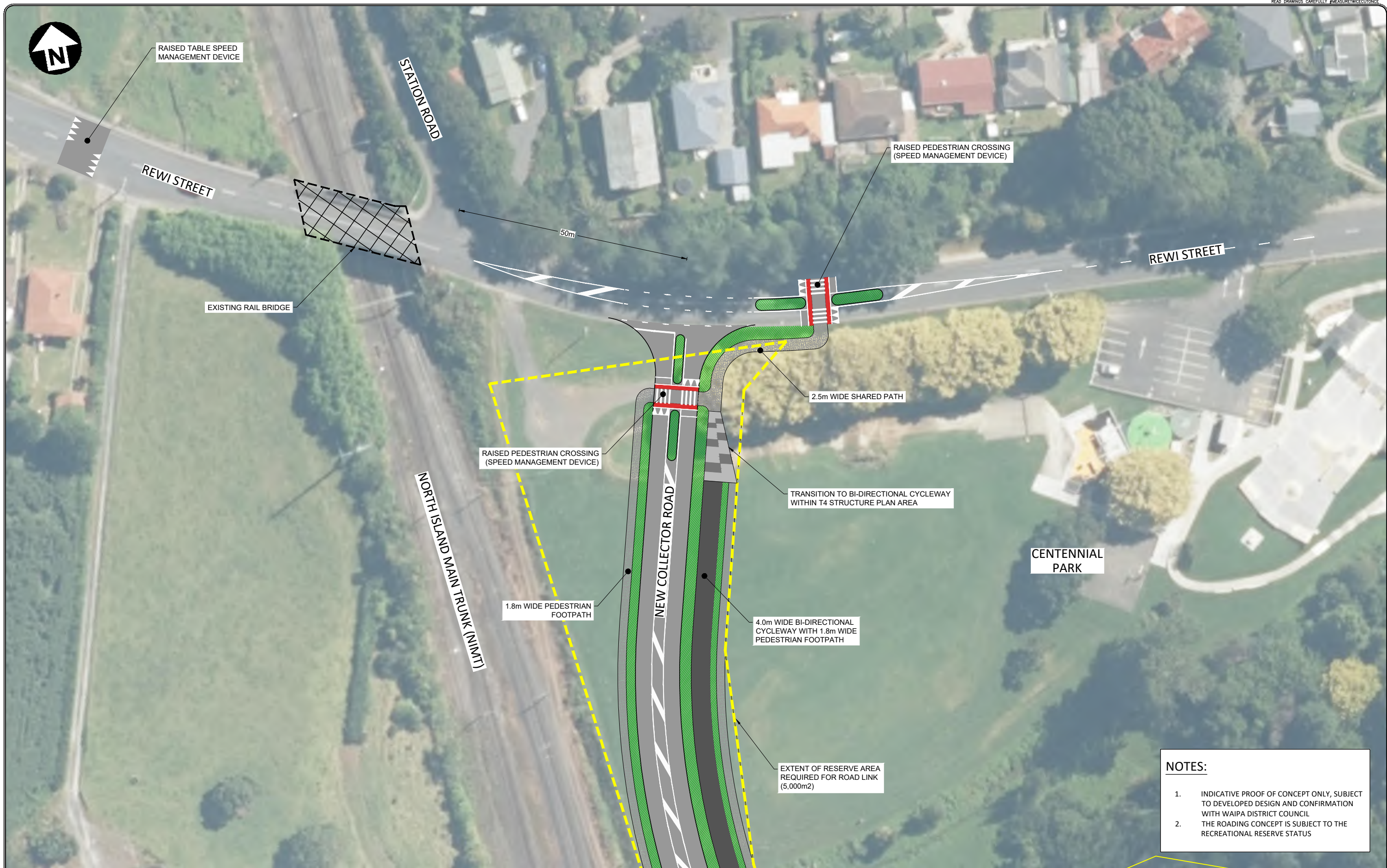
1. INDICATIVE PROOF OF CONCEPT ONLY, SUBJECT TO DEVELOPED DESIGN AND CONFIRMATION WITH WAIPA DISTRICT COUNCIL



1 TYPICAL CROSS SECTION - POKURU STREET
SCALE = 1:125

**PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU**

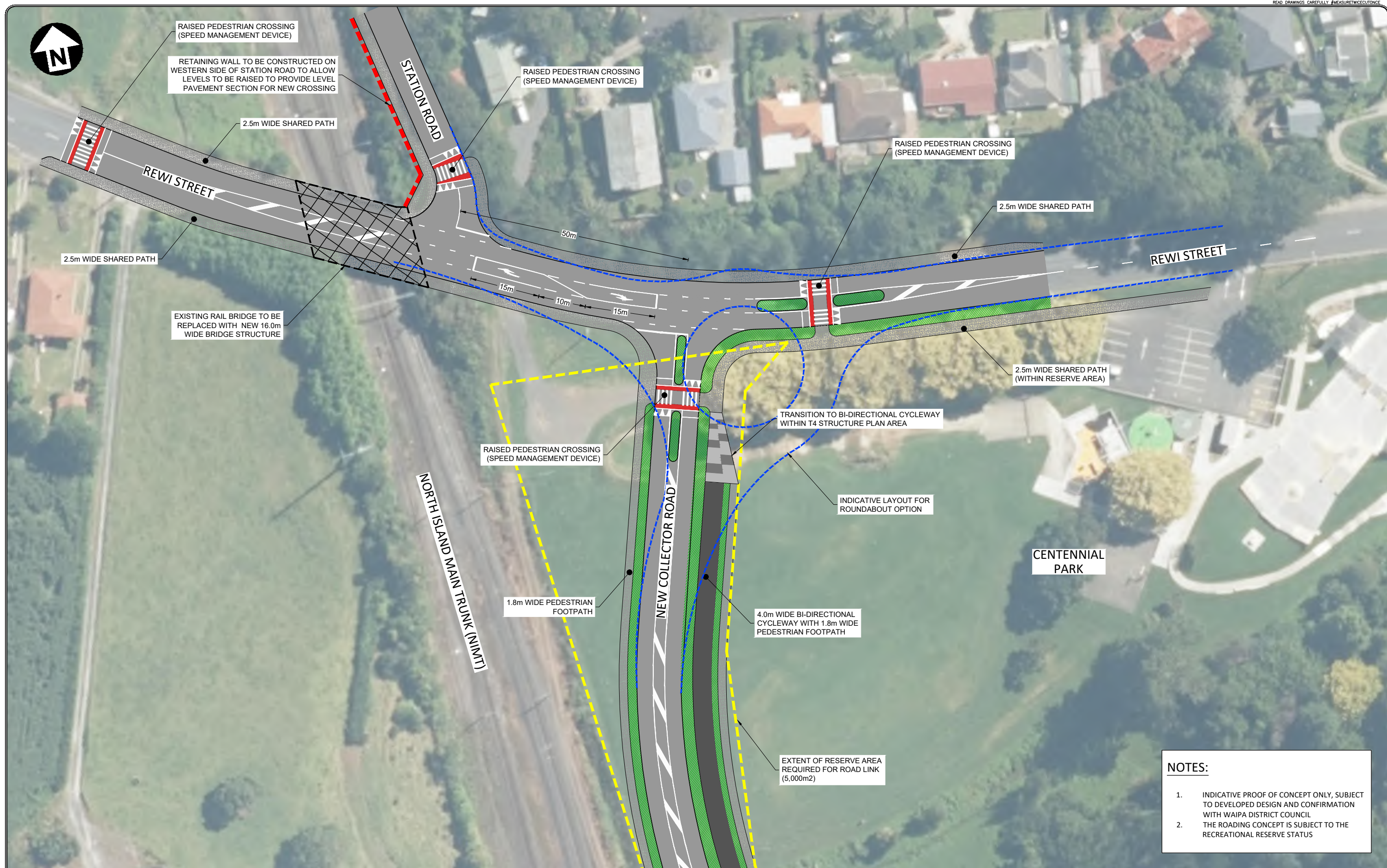
**POKURU/PUNIU ROAD INTERSECTION
INDICATIVE LAYOUT PLAN**



**PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU**

**INTERIM REWI STREET INTERSECTION
INDICATIVE LAYOUT PLAN**

DRAWING REVISION: E

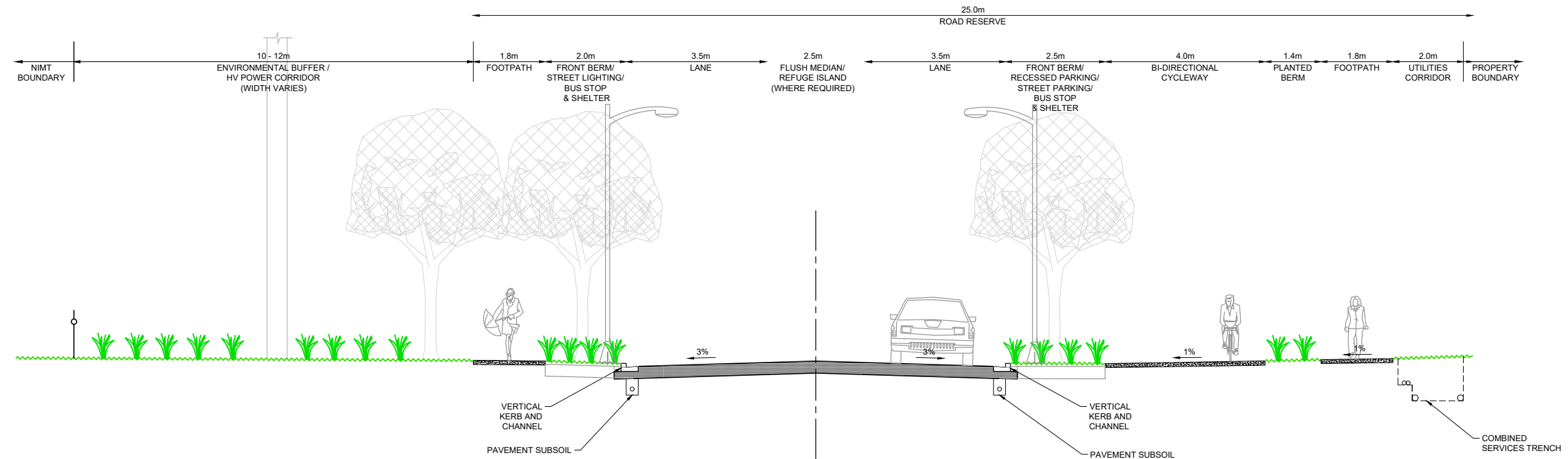


- NOTES:**
1. INDICATIVE PROOF OF CONCEPT ONLY, SUBJECT TO DEVELOPED DESIGN AND CONFIRMATION WITH WAIPA DISTRICT COUNCIL
 2. THE ROADING CONCEPT IS SUBJECT TO THE RECREATIONAL RESERVE STATUS

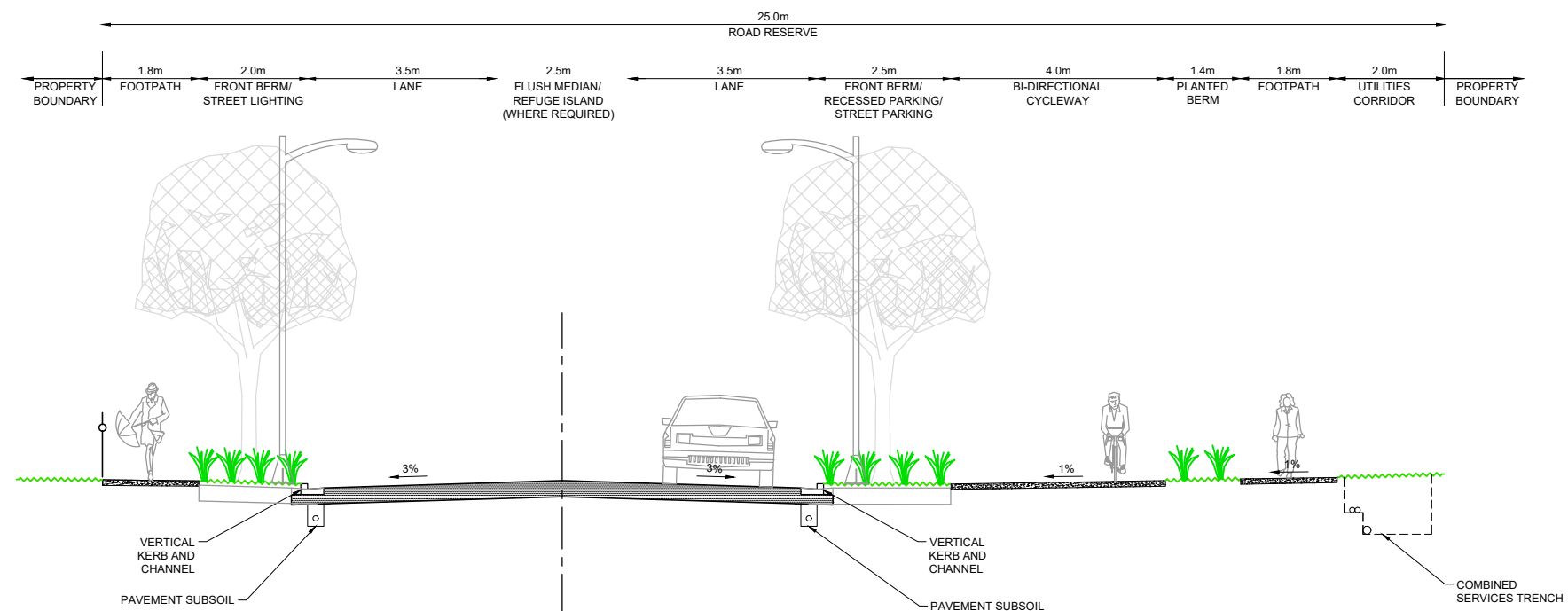
**PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU**

**FUTURE REWI STREET INTERSECTION
INDICATIVE LAYOUT PLAN**

DRAWING REVISION: B



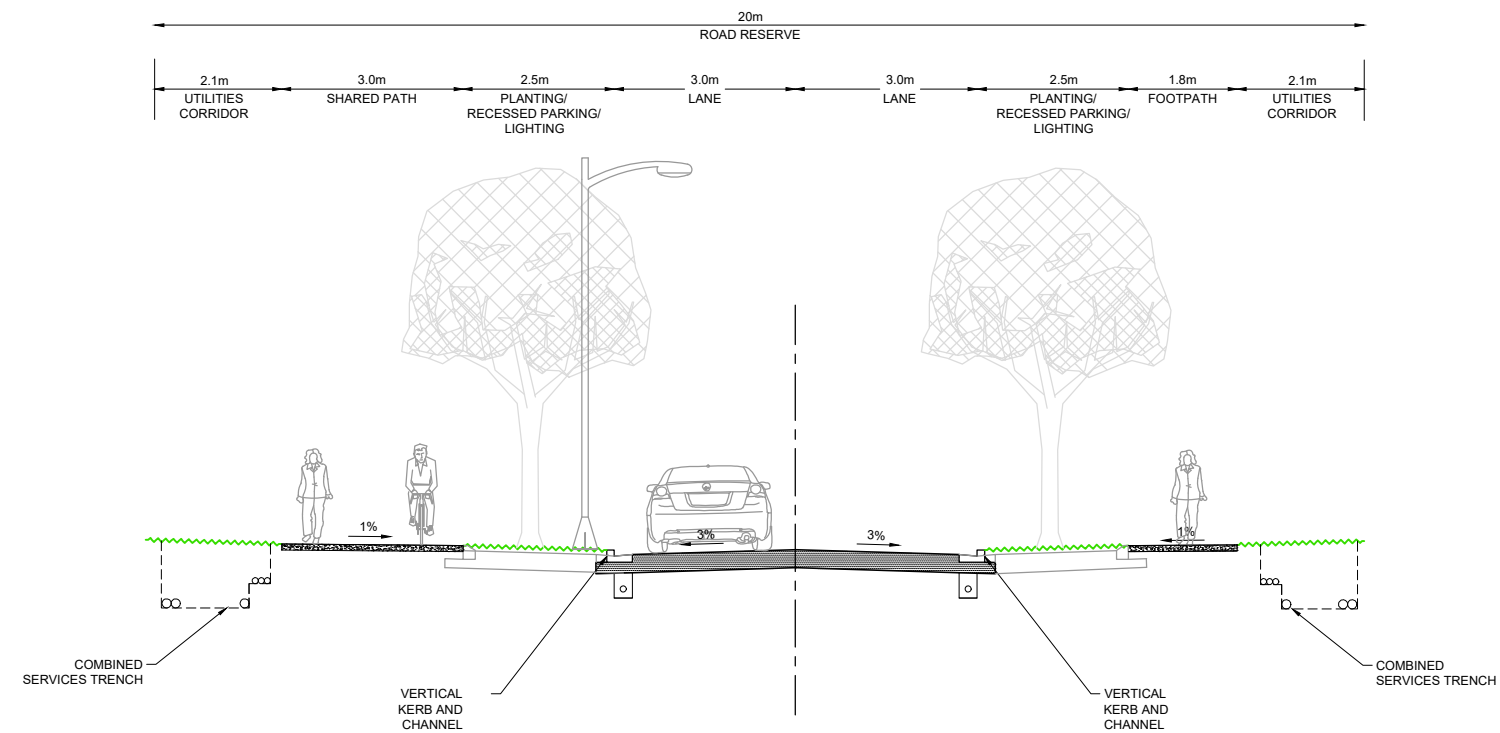
TYPICAL CROSS SECTION - COLLECTOR ROAD (25m / 50km/hr)
SCALE = 1:100



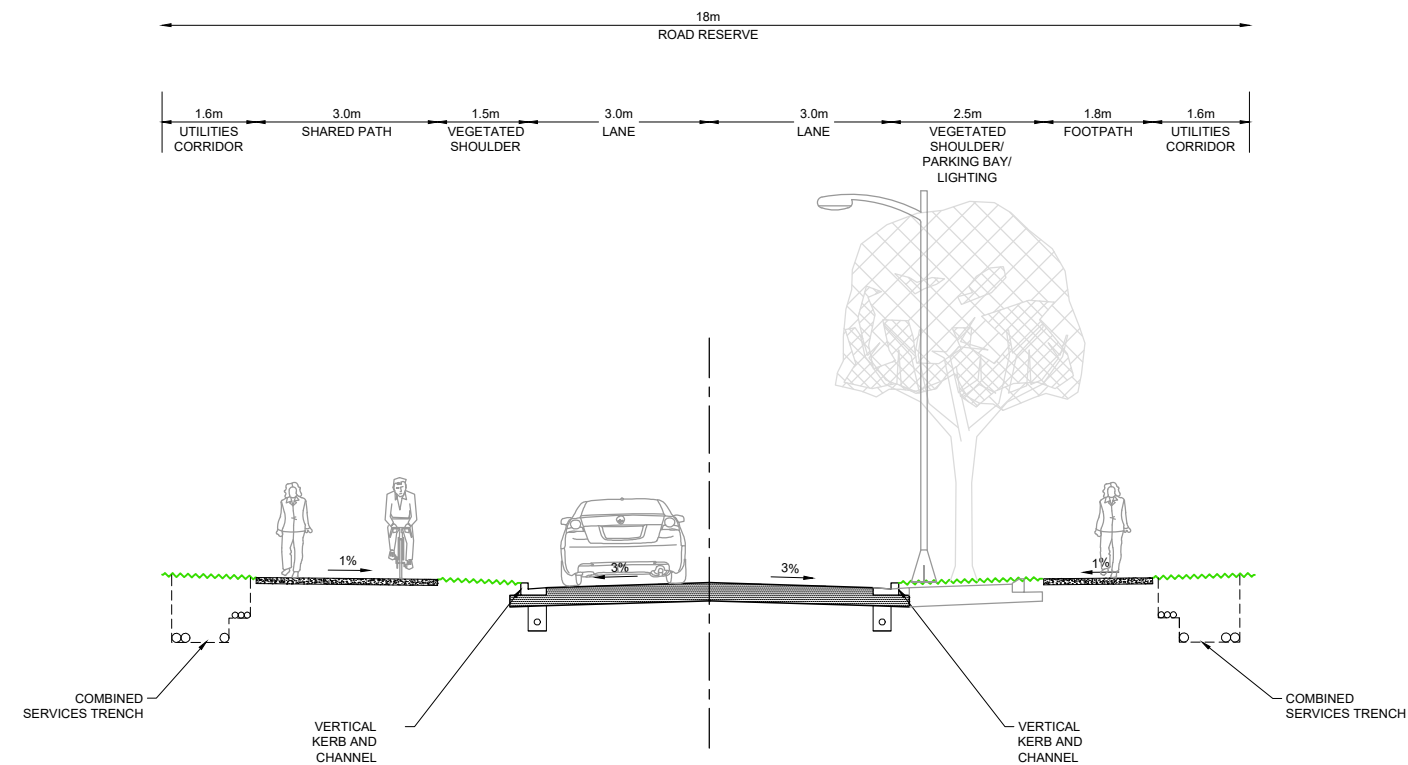
TYPICAL CROSS SECTION - COLLECTOR ROAD (25m / 50km/hr)
SCALE = 1:100

PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU

TRANSPORT NETWORK
TYPICAL CROSS SECTIONS
SHEET 1



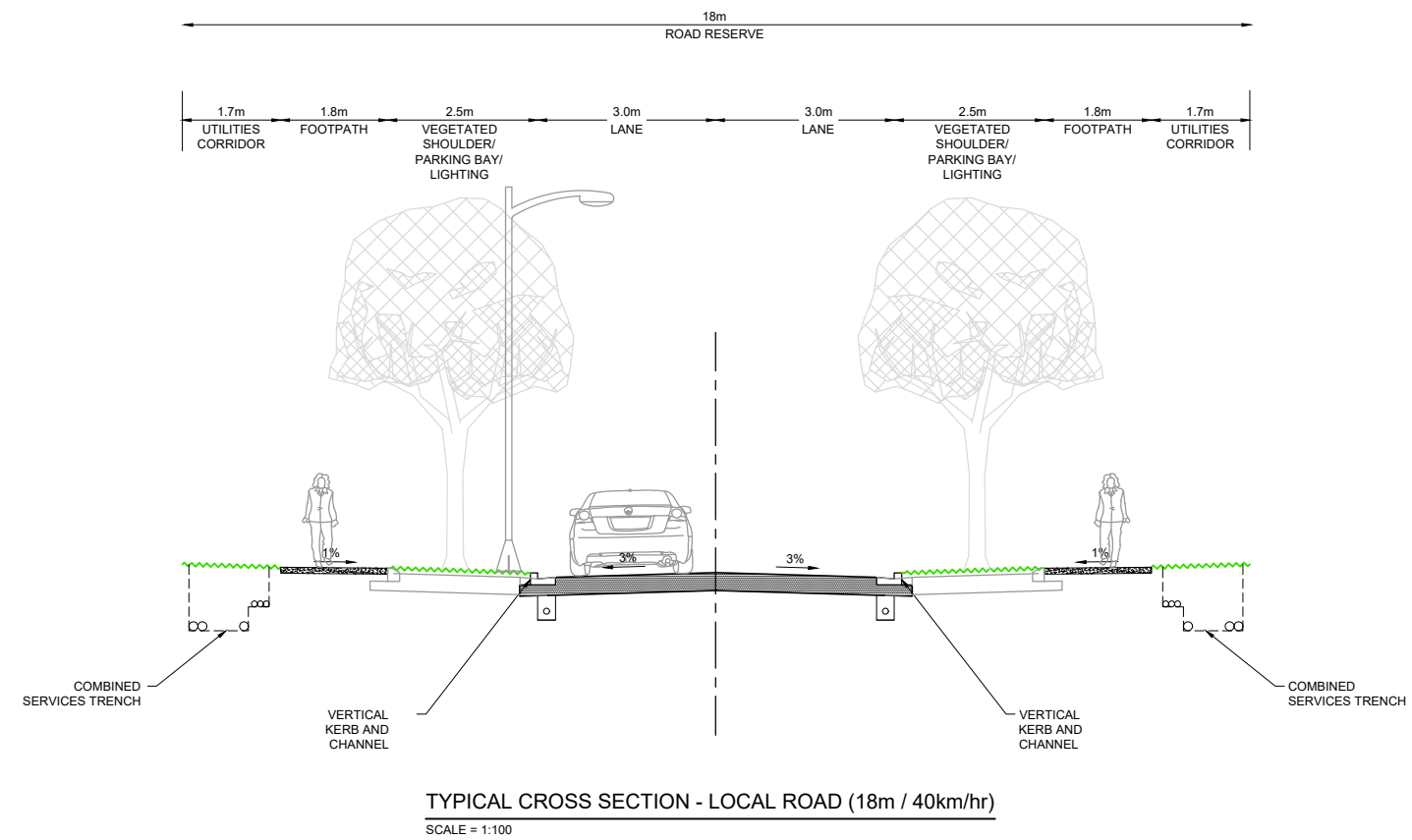
TYPICAL CROSS SECTION - LOCAL ROAD (20m / 50km/hr)
SCALE = 1:100



TYPICAL CROSS SECTION - LOCAL ROAD (18m / 40km/hr)
SCALE = 1:100

PROPOSED PLAN CHANGE T4 GROWTH CELL TE AWAMUTU

TRANSPORT NETWORK TYPICAL CROSS SECTIONS SHEET 2



**PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU**

**TRANSPORT NETWORK
TYPICAL CROSS SECTIONS
SHEET 3**



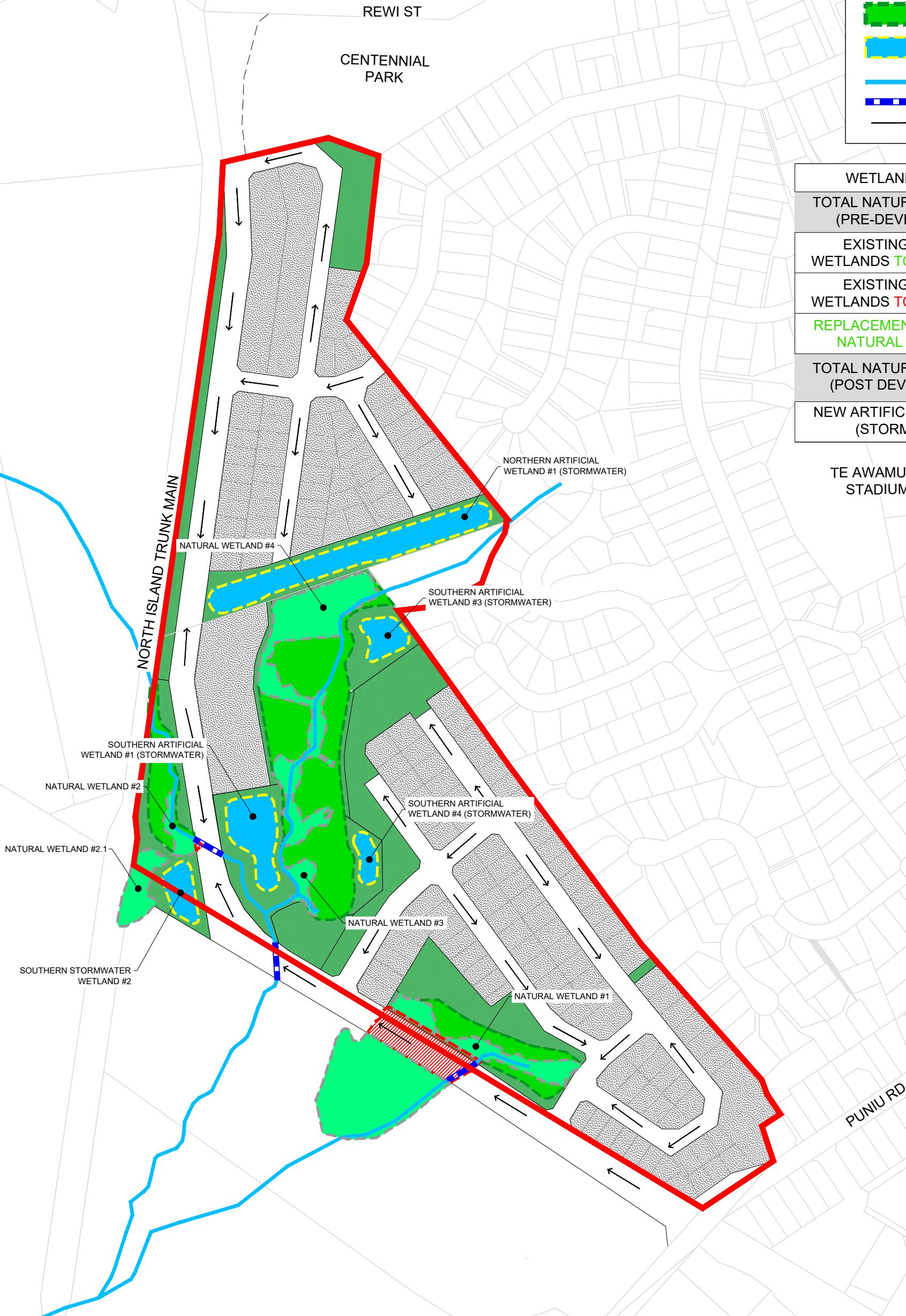
LEGEND

- OTHER ZONING (i.e. RESIDENTIAL)
- OPEN SPACE
- EXISTING NATURAL WETLANDS (TO BE RETAINED)
- EXISTING NATURAL WETLANDS (TO BE REMOVED)
- NEW NATURAL WETLANDS (INDICATIVE ONLY)
- NEW ARTIFICIAL STORMWATER WETLAND (INDICATIVE ONLY)
- EXISTING STREAM
- NEW CULVERT
- OVERLAND FLOW PATH (INDICATIVE)

WETLAND AREA ASSESSMENT

TOTAL NATURAL WETLANDS (PRE-DEVELOPMENT)	1.73 Ha
EXISTING NATURAL WETLANDS TO BE RETAINED	1.38 Ha
EXISTING NATURAL WETLANDS TO BE REMOVED	0.35 Ha
REPLACEMENT/ADDITIONAL NATURAL WETLANDS	2.12 Ha
TOTAL NATURAL WETLANDS (POST DEVELOPMENT)	3.50 Ha (+102%)
NEW ARTIFICIAL WETLANDS (STORMWATER)	1.36 Ha

TE AWAMUTU STADIUM

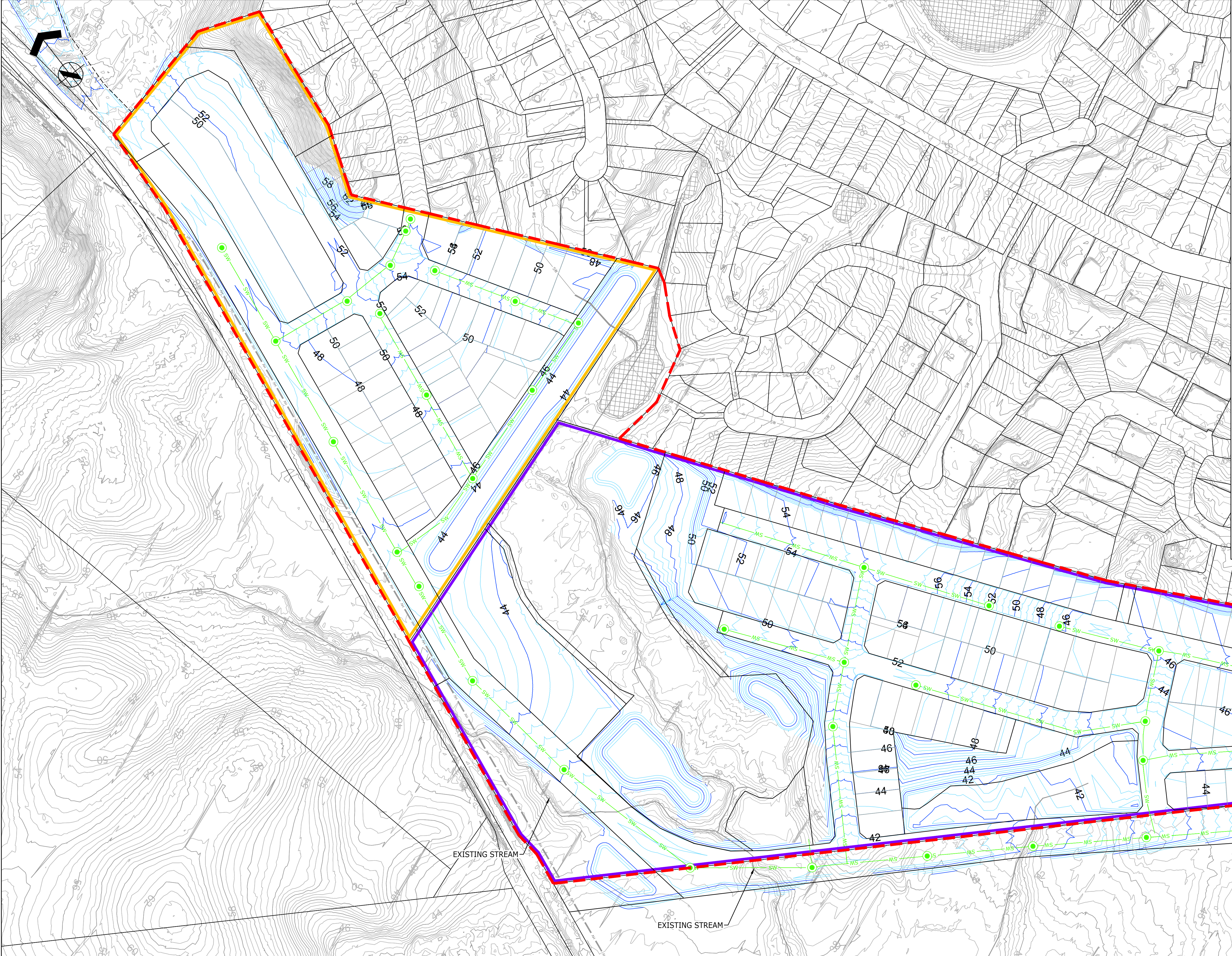


PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU

STORMWATER

APPENDIX 3

WATER AND WASTEWATER SKETCHES



NOTES

- 1. ALL WORKS TO BE DONE IN ACCORDANCE WITH THE CURRENT W.L.A.S.S. REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATIONS AND/OR THE T.A. INFRASTRUCTURE GENERAL MANAGER AND WITH THE REQUIREMENTS OF THE BUILDING CODE
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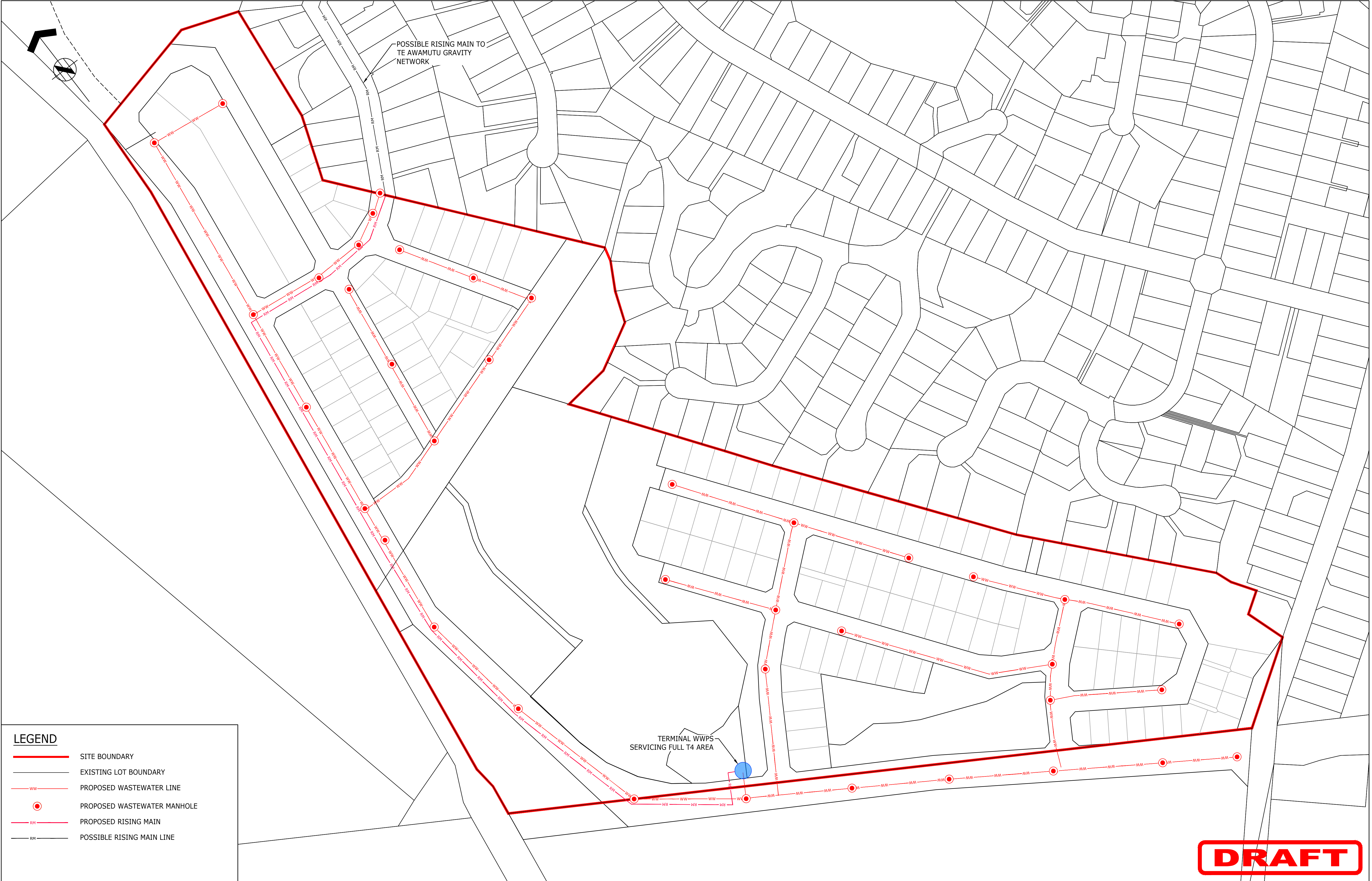
LEGEND

- SITE BOUNDARY
- EXISTING LOT BOUNDARY
- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- PROPOSED CONTOUR MAJOR
- PROPOSED CONTOUR MINOR
- SW --- EXISTING STORMWATER
- ⊙ EXISTING MANHOLE (PUBLIC)
- SW --- PROPOSED STORMWATER LINE
- ⊙ PROPOSED STORMWATER MANHOLE
- INDICATIVE WETLAND LOCATION
- STORMWATER CATCHMENT NORTHERN EXTENT
- STORMWATER CATCHMENT SOUTHERN EXTENT

DRAFT

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				DRAWN:	DATE:	SIGNED:	PLOT DATE:	05.07.24										PROJECT No:		SCALES:	A1 1:2000 A3 1:4000	A1	
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LEGEND

SITE BOUNDARY

EXISTING LOT BOUNDARY

WW

PROPOSED WASTEWATER LINE

PROPOSED WASTEWATER MANHOLE

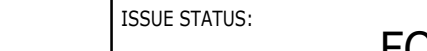
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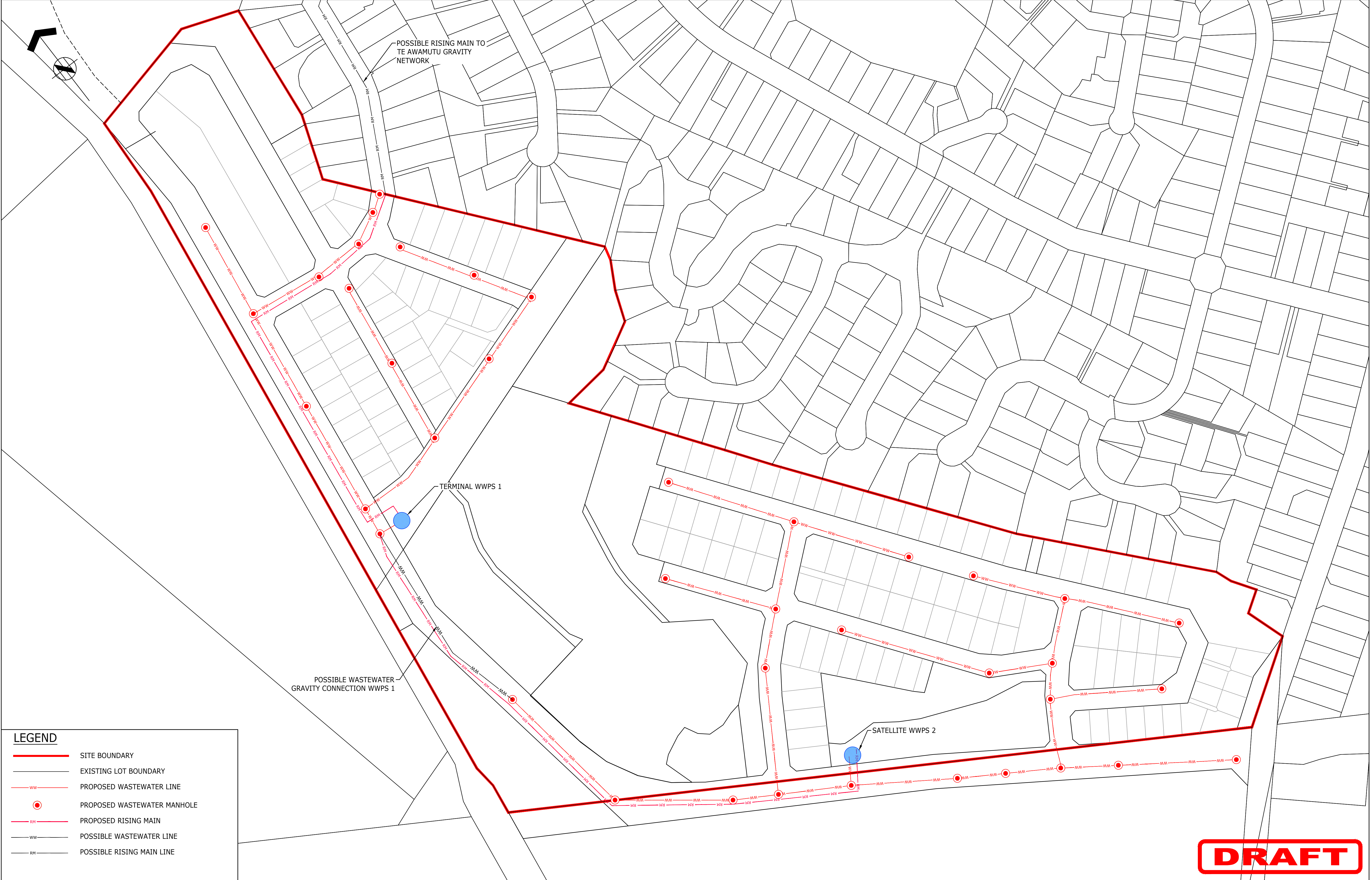
PROPOSED RISING MAIN

RM

POSSIBLE RISING MAIN LINE

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LEGEND

ww

RM

ww

RM

SITE BOUNDARY

EXISTING LOT BOUNDARY

PROPOSED WASTEWATER LINE

PROPOSED WASTEWATER MANHOLE

PROPOSED RISING MAIN

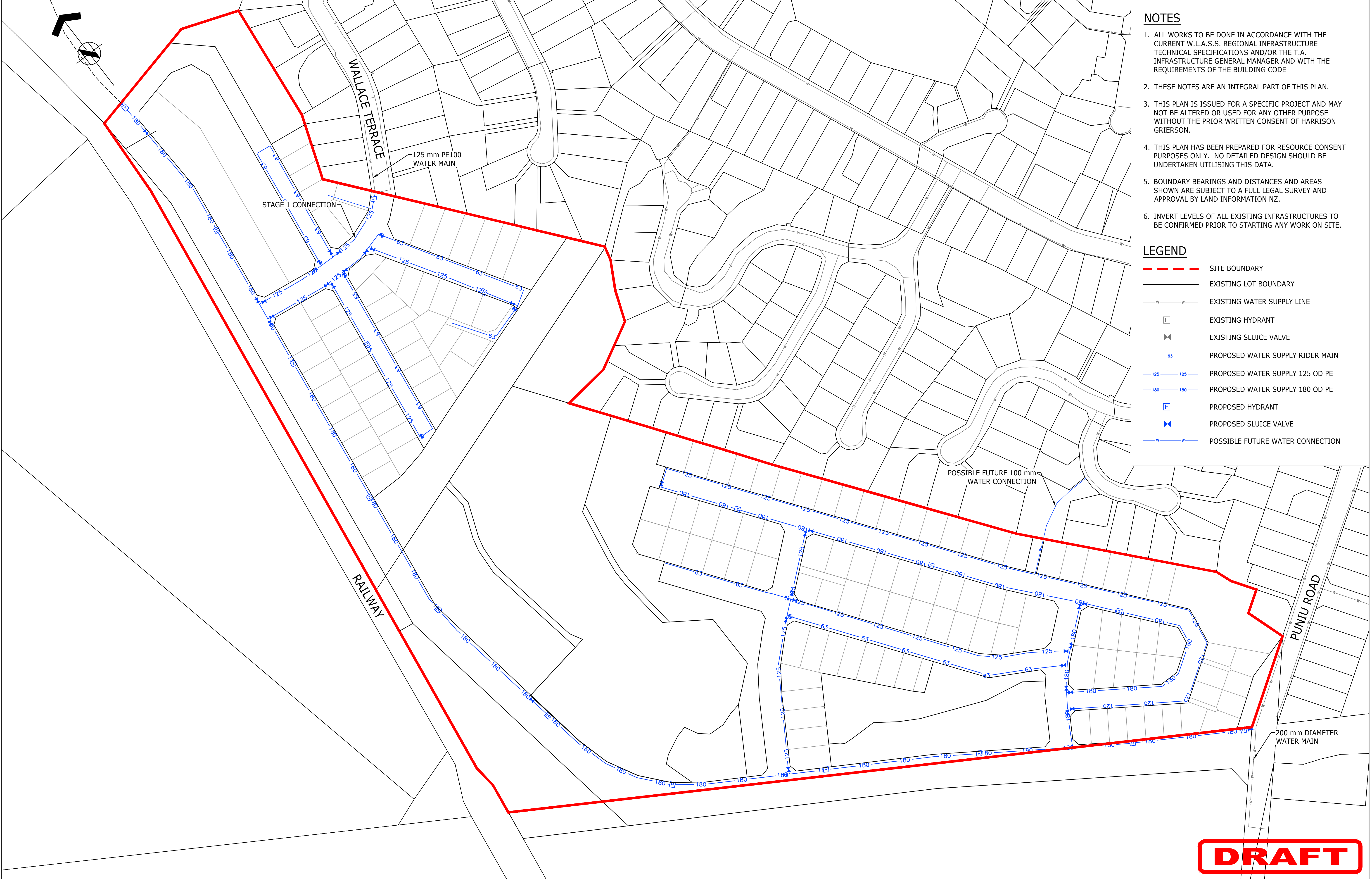
POSSIBLE WASTEWATER LINE

POSSIBLE RISING MAIN LINE

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			BY	DATE	APPROVED:	DATE:	SIGNED:	SURVEY DATE:										

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NOTES

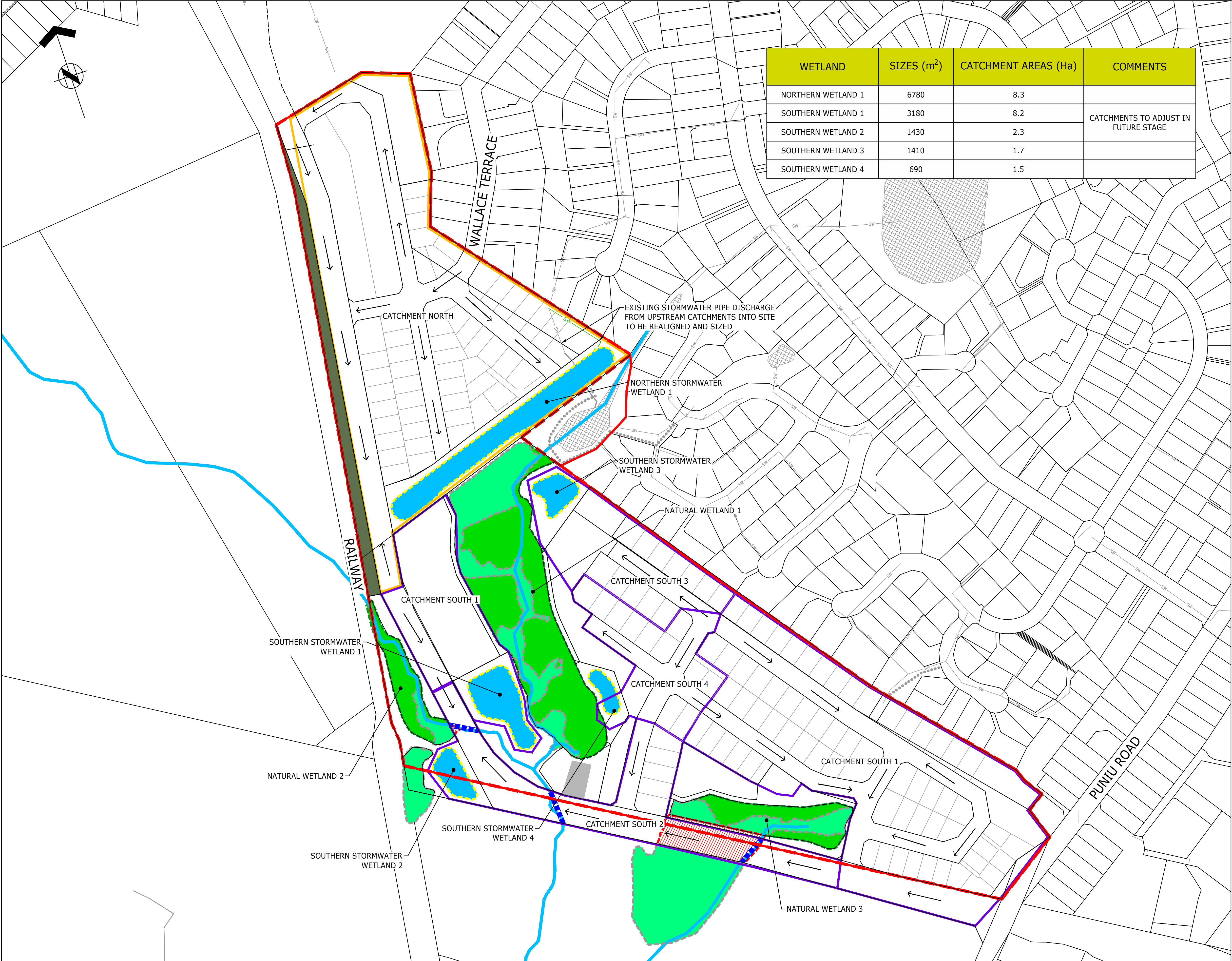
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- 6. INVERT LEVELS OF ALL EXISTING INFRASTRUCTURES TO BE CONFIRMED PRIOR TO STARTING ANY WORK ON SITE.

LEGEND

- SITE BOUNDARY
- EXISTING LOT BOUNDARY
- W --- W --- EXISTING WATER SUPPLY LINE
- [H] EXISTING HYDRANT
- ⌞ EXISTING SLUICE VALVE
- 63 --- PROPOSED WATER SUPPLY RIDER MAIN
- 125 --- 125 --- PROPOSED WATER SUPPLY 125 OD PE
- 180 --- 180 --- PROPOSED WATER SUPPLY 180 OD PE
- [H] PROPOSED HYDRANT
- ⌞ PROPOSED SLUICE VALVE
- W --- W --- POSSIBLE FUTURE WATER CONNECTION

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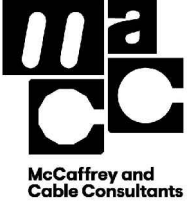
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- BOUNDARY BEARINGS AND DISTANCES AND AREAS SHOWN ARE SUBJECT TO A FULL LEGAL SURVEY AND APPROVAL BY LAND INFORMATION NZ.
- WETLAND LOCATIONS WITH 10m BUFFER DISTANCE FROM THE EXISTING NATURAL WETLANDS. ACCEPTABLE BUFFER DISTANCES TO BE CONFIRMED WITH ECOLOGIST.
- THE PRESENTED WETLANDS WERE SIZED FOR WATER QUALITY TREATMENT AND EXTENDED DETENTION. ADDITIONAL AREAS WILL BE NEEDED FOR 100-YEAR ATTENUATION, TO BE CONFIRMED WITH FLOOD MODELLING ASSESSMENT.
- THE PROPOSED CATCHMENTS ARE INIDICATIVE AND BASED ON WETLAND LOCATIONS. DESIGN SURFACE TO BE ADJUSTED TO SUIT OR STORMATER RESERVES TO SHIFT TO LOCATIONS THAT ALIGN WITH CURRENT SURFACE DESIGN.
- STORMATER MANAGEMENT FOR EXTERNAL CATCHMENTS ARE ASSUMED TO BE PROVIDED EXTERNALLY AND WERE NOT INCLUDED IN THE WETLANDS SIZING.

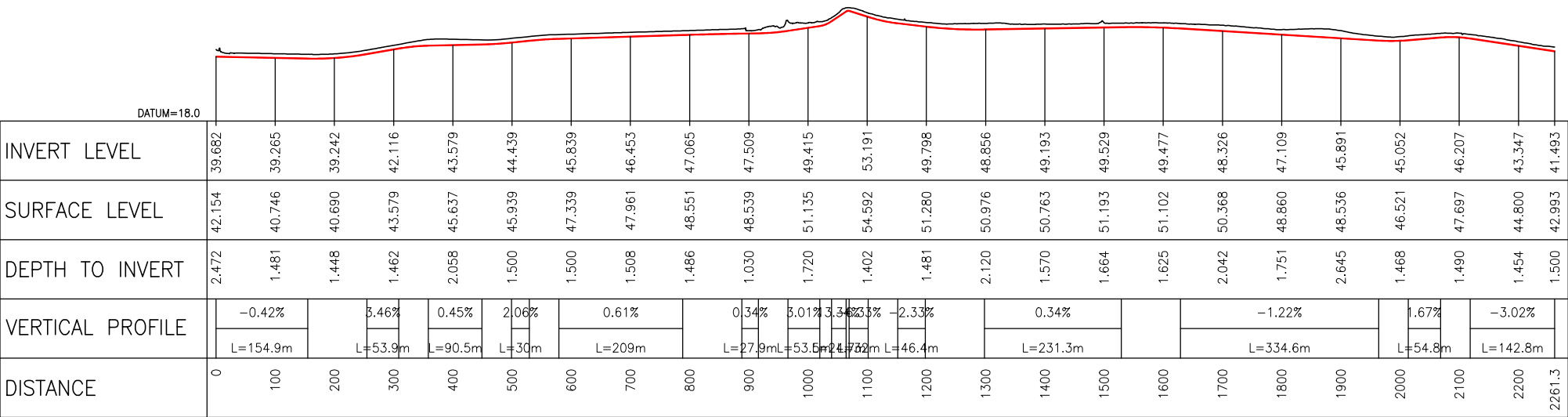
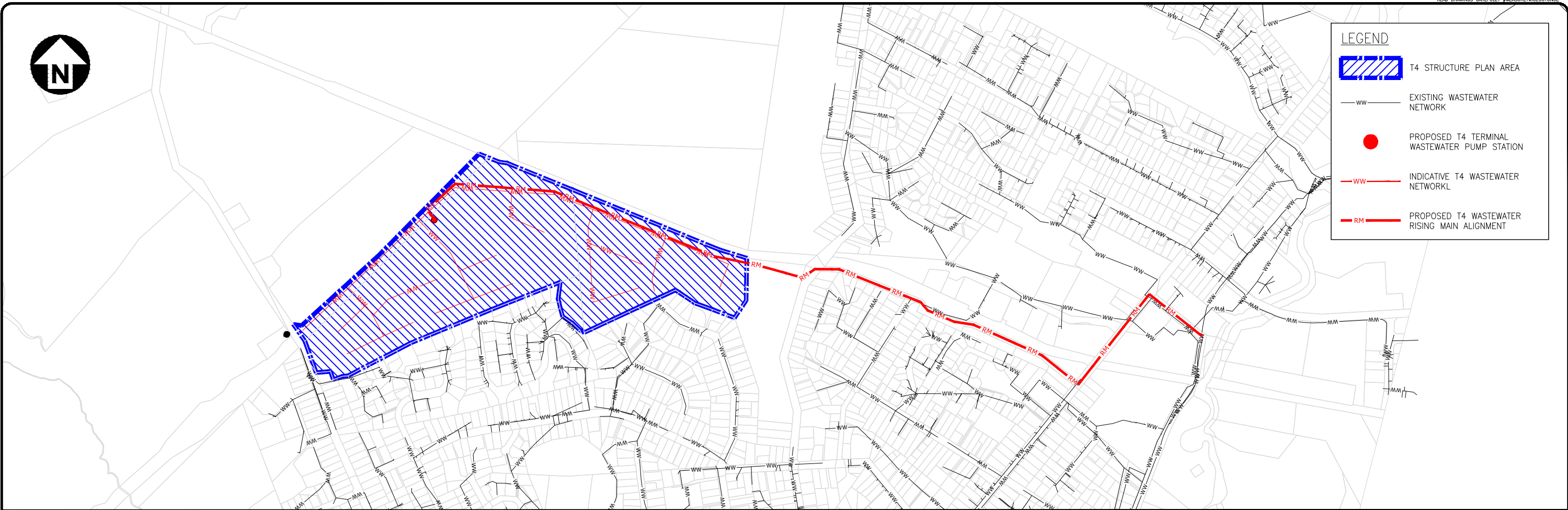
LEGEND

- SITE BOUNDARY
- EXISTING LOT BOUNDARY
- SW --- EXISTING STORMWATER
- ⊙ EXISTING MANHOLE (PUBLIC)
- SW --- PROPOSED STORMWATER LINE
- STORMWATER CATCHMENT NORTHERN EXTENT
- STORMWATER CATCHMENT SOUTHERN EXTENT
- EXISTING NATURAL WETLANDS (TO BE RETAINED)
- EXISTING NATURAL WETLAND (TO BE REMOVED)
- NEW NATURAL WETLAND (INDICATIVE ONLY)
- NEW STORMWATER WETLAND (INDICATIVE ONLY)
- OVERLAND FLOW PATH (INDICATIVE)

DRAFT

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LONGITUDINAL SECTION – T4 RISING MAIN ALIGNMENT OPTION (RM1)

HORIZONTAL SCALE=1:10000; VERTICAL SCALE=1:2000

A	FOR INFORMATION	LPM	03.05.24
REV	DESCRIPTION	BY	DATE

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DESIGNED BY	L. MCCAFFREY	DATE	12.04.24
DRAWN BY	G. JONES	DATE	12.04.24
APPROVED BY		DATE	

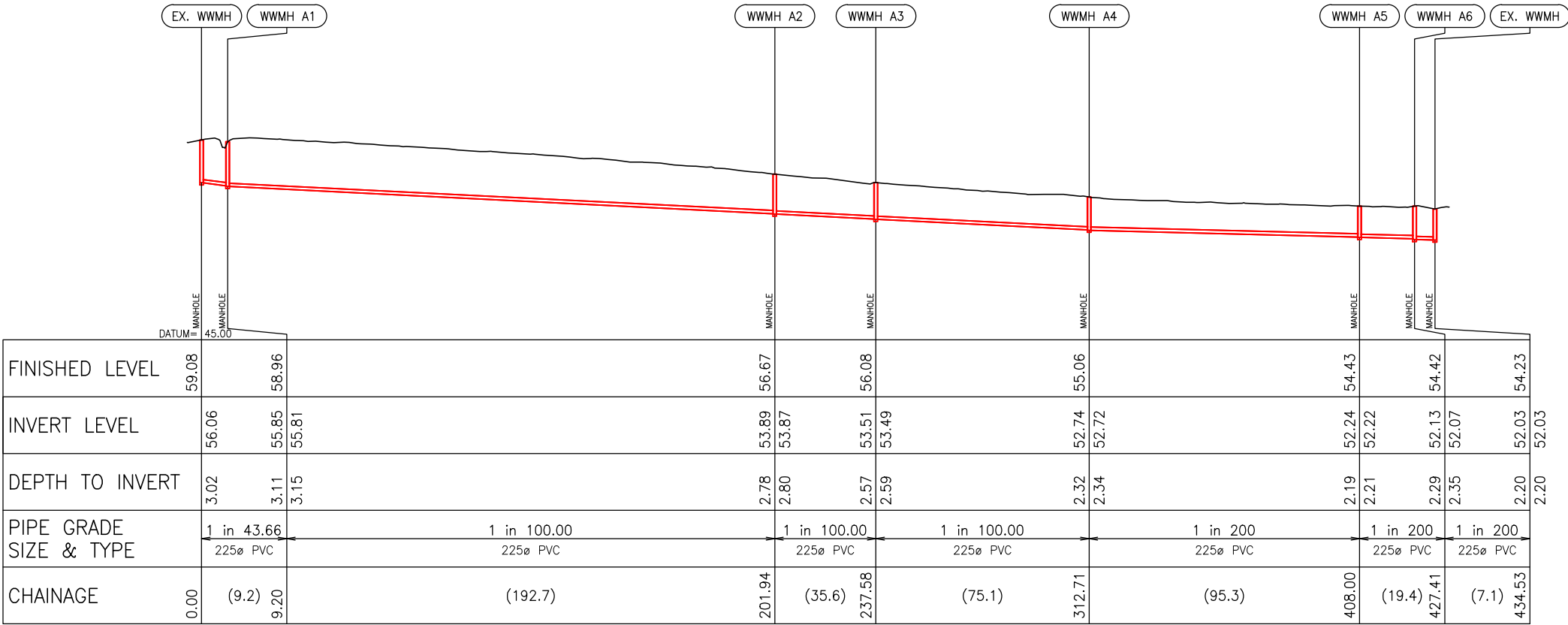
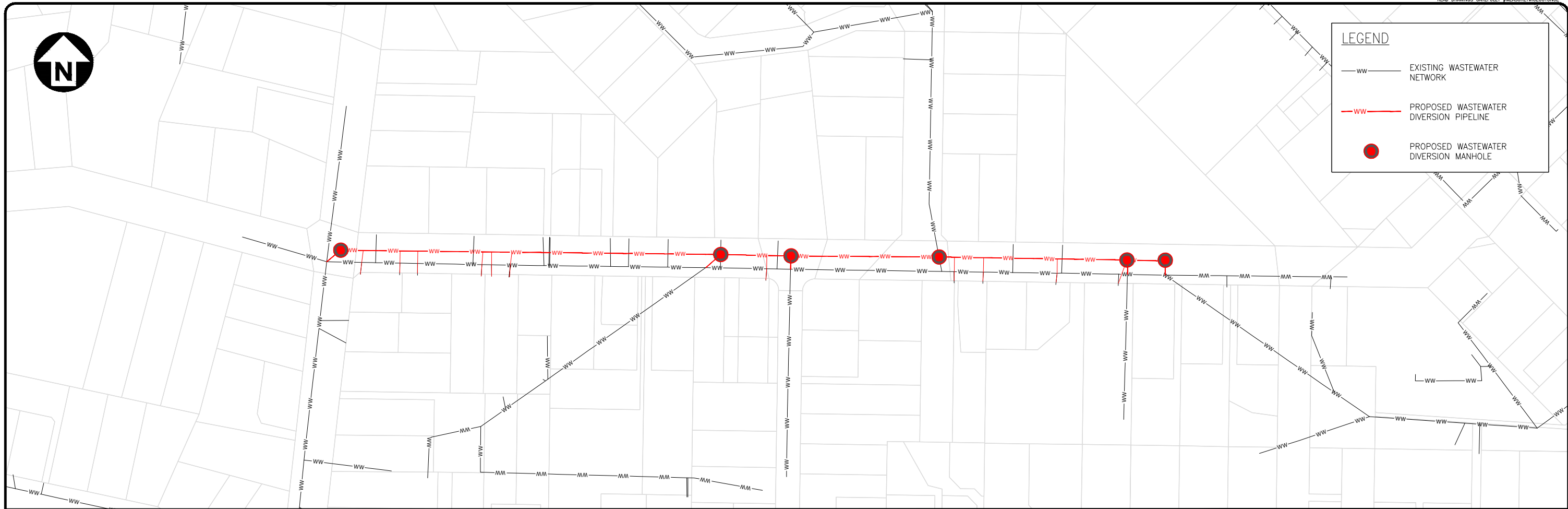
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LYN CUDBY & PINGING YU

PROJECT NAME
T4 STRUCTURE PLAN

DRAWING TITLE
WASTEWATER OPTION 2 WESTERN RISING MAIN
PLAN & LONGITUDINAL SECTION

PRODUCED BY
McCaffrey and Cable Consultants

DRAWING SCALE	AS SHOWN	REVISION No.
DISCIPLINE	CIVIL ENGINEERING	A
DRAWING No.	22029-SK-010	



A	FOR INFORMATION	LPM	08.05.24
REV	DESCRIPTION	BY	DATE

APPROVAL STATUS	
FOR INFORMATION	
DESIGNED BY	DATE
L. MCCAFFREY	08.05.24
DRAWN BY	DATE
G. JONES	08.05.24
APPROVED BY	DATE

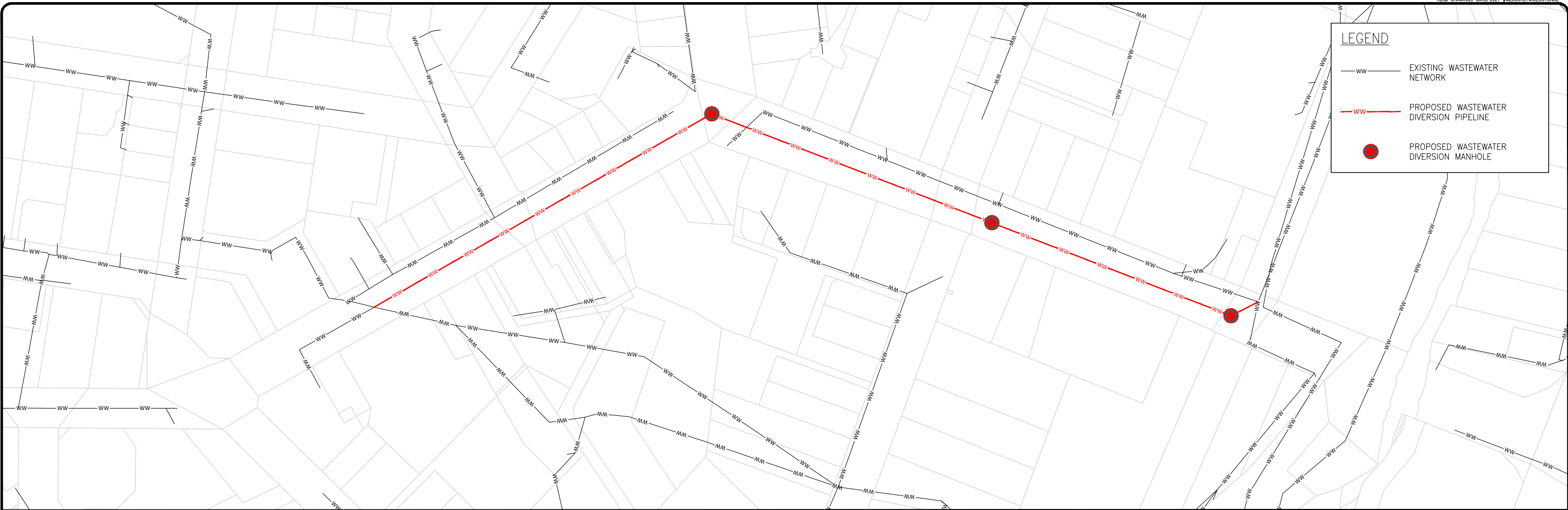
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LYN CUDBY & PINGING YU

PROJECT NAME
T4 STRUCTURE PLAN

DRAWING TITLE
WASTEWATER OPTION 1 EXISTING NETWORK UPGRADE DIVERSION #1 PLAN & LONGITUDINAL SECTION

PRODUCED BY
McCaffrey and Cable Consultants

DRAWING SCALE	REVISION No.
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DISCIPLINE	
CIVIL ENGINEERING	
DRAWING No.	
22029-SK-011	



LEGEND

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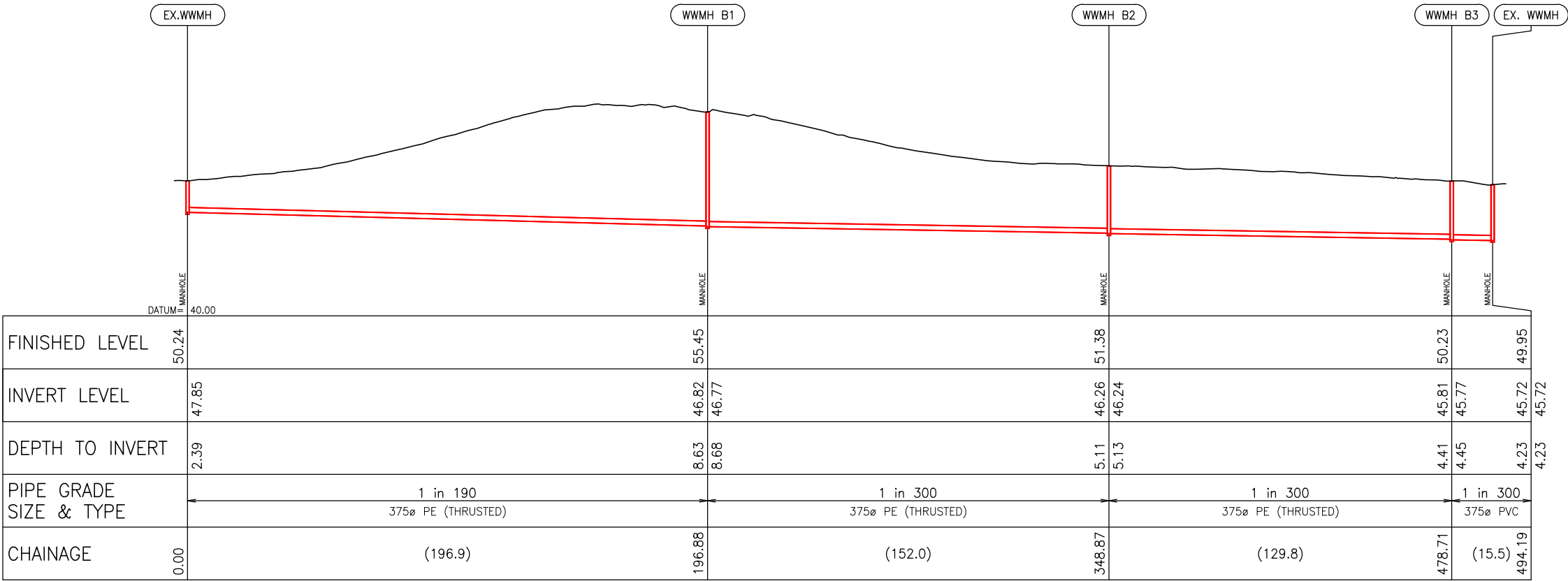
EXISTING WASTEWATER NETWORK

— WW —

PROPOSED WASTEWATER DIVERSION PIPELINE

●

PROPOSED WASTEWATER DIVERSION MANHOLE



LONGITUDINAL SECTION – DIVERSION #1

A	FOR INFORMATION	LPM	08.05.24	
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APPROVAL STATUS	
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CLIENT NAME
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PROJECT NAME
T4 STRUCTURE PLAN

DRAWING TITLE
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PRODUCED BY

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DISCIPLINE	
CIVIL ENGINEERING	
DRAWING No.	
22029-SK-012	

APPENDIX 4

WSP WASTEWATER MODELLING REPORT



Memorandum

To	Matthew Farrell
Copy	Harry Baxter, Robin Walker, Kristina Macnaughtan
From	Sphurti Sawant
Office	Hamilton
Date	16 July 2024
File/Ref	Click or tap here to enter text.
Subject	T4 Development Wastewater Modelling Assessment
Status	Final

Executive Summary

WDC has enlisted the services of WSP to assess the potential effects on the local Wastewater (WW) networks to support the forthcoming developments in T4 growth cells. WSP has analysed the potential impacts and communicated its findings through this memorandum.

The following scenarios mentioned were created as per the scope after updating the model.

Table 0-1 Overview Summary

Scenarios	Description	Outcomes	Remarks
Base	Wastewater 2022 base model	162 pipes surcharged. 3 potential overflows.	-
Scenario 1	Wastewater 2022 base model network + T1, T2 and T9 future developments	162 pipes surcharged. 4 potential overflows.	Network unable to cater PWWF from T1, T2 and T9 development
Scenario 2 – Option 1	T4 North discharges to manhole 1091129	170 pipes surcharged.	Network able to cater PWWF of 5.2 l/s from T4 North development without surcharging.
	T4 South discharges to manhole 1090696	4 potential overflows.	Network unable to cater PWWF of 8.7 l/s from T4 South development.

Scenario 2 – Option 1.1	T4 North discharges to manhole 1090776	166 pipes surcharged.	Network unable to cater PWWF of 5.2 l/s from T4 North development.
	T4 South discharges to manhole 1090696	5 potential overflows.	Network unable to cater PWWF of 8.7 l/s from T4 South development.
Scenario 2 – Option 2	T4 North and T4 South discharges to manhole 1090776	163 pipes surcharged. 4 potential overflows.	Network unable to cater PWWF of 13.9 l/s from T4 development.
Scenario 2 – Option 2.1	T4 North and T4 South discharges to 1091129	173 pipes surcharged. 3 potential overflows.	Network unable to cater PWWF of 13.9 l/s from T4 development.

1 Introduction

1.1 Background

Waipā District Council (WDC), on behalf of McCaffrey & Cable Consultants Ltd, has engaged WSP to carry out a wastewater modelling assessment for the T4 growth cell in Te Awamutu. The extent of the proposed development is shown in Figure 1-1.



Figure 1-1 Extent of the proposed T4 development

1.2 Scope

The scope of this assessment is to connect the proposed T4 network with the existing Te Awamutu wastewater network and to assess the performance in terms of the Level of Services (LoS). This assessment will investigate if the existing wastewater has the capacity for the proposed development to meet the LoS requirements.

The assessment will also identify any adverse impacts on the existing wastewater network.

2 Acceptance Criteria

The following criteria were used for the hydraulic assessment:

- Potential network constraints downstream of the proposed development connection were assessed.
- The assessment of the impact of the proposed development has been undertaken in terms of:
 - ✓ Overflows – manholes
 - ✓ Surge State - pipes
- Table 2-1 below summarises the different pipe states.

Table 2-1 Gravity Pipe Conditions

Modelled Surge State	Description
≤ 0.8	The pipe is running at its 80% capacity
>0.8	Pipe Capacity Exceeded 80% capacity

The above criteria was used on maps indicating the performance analysis of the wastewater network for the proposed development.

3 Methodology



Figure 3-1 Proposed connection to service T4 development.

Our proposed methodology to provide the wastewater assessment is as follows:

1. Digitise the proposed development in the WW model including the proposed connections as shown in Figure 3-1.
2. Run the WW model with the 5-year ARI design event.
3. Understand the capacity available in the network to identify preferred discharge locations.
4. **Assess** - WWPS 1 + WWPS 2 discharging to the same manhole – PWWF 5.2 l/s+8.7l/s respectively.
5. **Assess** - If insufficient network capacity is available assess two separate discharge locations for WWPS 1 and WWPS 2. WDC does not want the WWPS sharing a discharge manhole.
6. **Hold Point** - The results of the work above should be discussed with WDC before moving to the next stage.

Table 3-1 Flow from development

Zone	Catchment area (ha)	Total Lots	Pop Equivalent	Peaking factor	ADF l/s	PWW F l/s
T4 North	8.99	74	400	3.50	1.20	5.2
T4 South	18.25	118	638	3.10	2.00	8.7
Combined	27.24	192	1037	3.00	3.10	13.9

4 Model Assumptions

The assumptions below have been used in this modelling assessment.

- WSP will not consider the specific requirements of how the development will connect to the existing wastewater system.
- The assessment will consider the 5-year 2-hour rainfall as the critical duration.
- WSP will use the Te Awamutu 2022 base model scenario for this assessment.
- No model updates will be made other than those outlined in the scope of work i.e., representation of development flows.
- Pumps ON/OFF are set based on general modelling assumption with 100mm dead storage.
- Pumps are used to pump the flow 24/7 based on the PWWF discharge from the development, which is modelled as a static flow.
- WSP will not model any pipework to service T4 development with the option of discharging the WW flow to the network.
- The RiTS (static) flow provided by Harrison Grierson will be used to predict the impact on the network.
- Storage will be assessed with the scaled-up dynamic profile.

5 Modelling Scenarios

Table 5-1 summarises the modelling scenarios, which have been discussed and confirmed with WDC.

Table 5-1 T4 Development Modelling Scenarios

Scenario	Network
1	Wastewater 2022 base model network + T1, T2 and T9 future developments
2	Wastewater 2022 base model network with T4 North and T4 South development. Identifying the preferred discharge location/s.

6 Results

This section discusses the results of the wastewater modelling assessment against the acceptance criteria.

6.1 Base Model Results

As shown in Figure 6-1 the Baseline model, the downstream sewer has capacity without the addition of T4 development in the model.

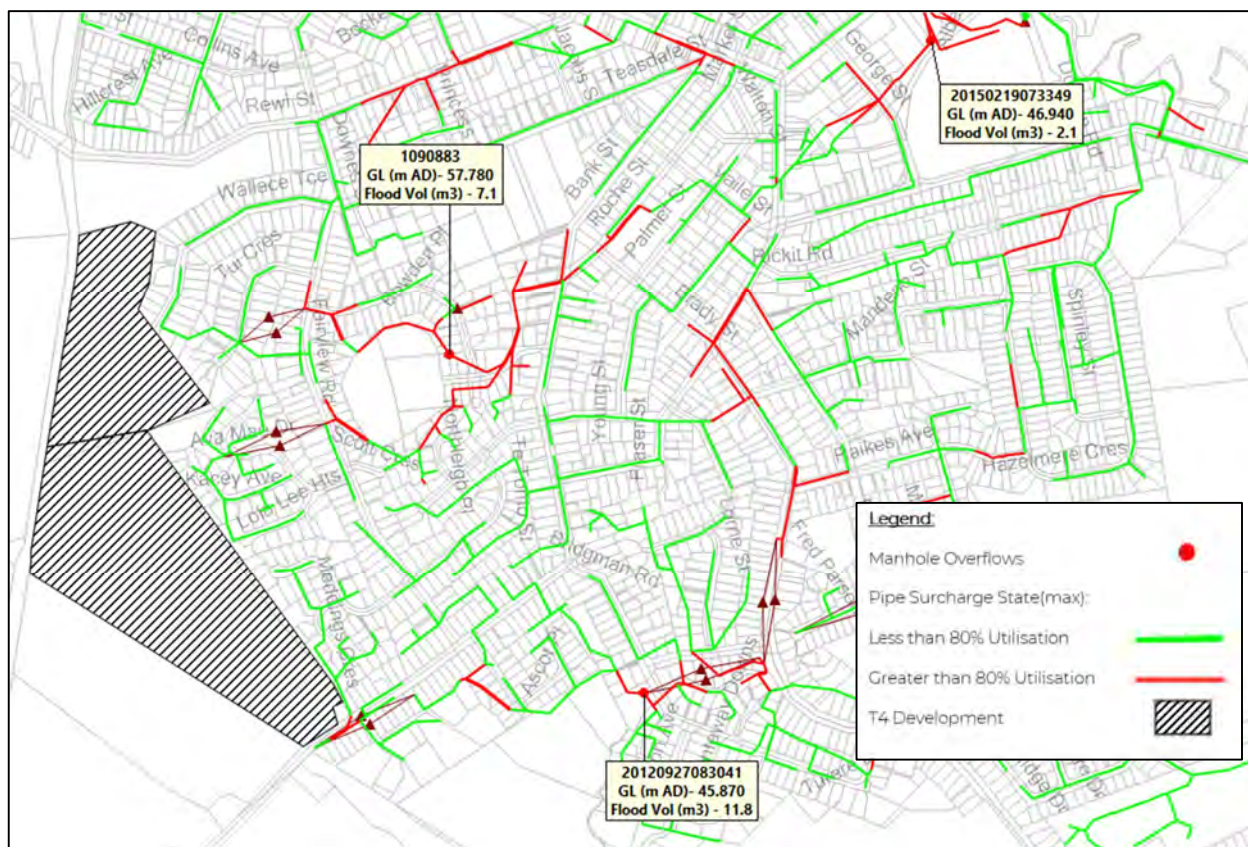


Figure 6-1 LoS results of the base model.

Table 6-1 provides a high-level overview of the model result respective to surcharged pipes and overflow within the local network near T4 development as shown in Figure 6-1.

Table 6-1 Baseline simulation Result Overview for 5 years 2 hr design rainfall

Scenario	Number of overflows	Maximum flood volume (m³)	Number of Pipe surcharge
Baseline	3	Manhole 20120927083041 – 11.8	162

6.2 Base Model Results with Development

This section of the report discusses the LoS results of the base model with the addition of T1, T2, T4 and T4 development.

6.3 Scenario 1 - Wastewater 2022 base model network + T1, T2 and T9 future developments

T1, T2 and T9 development have been included in the scenario concerning the wastewater flow in the network. The maximum PWWF identified for the development site loaded directly to the manhole as per the future growth.

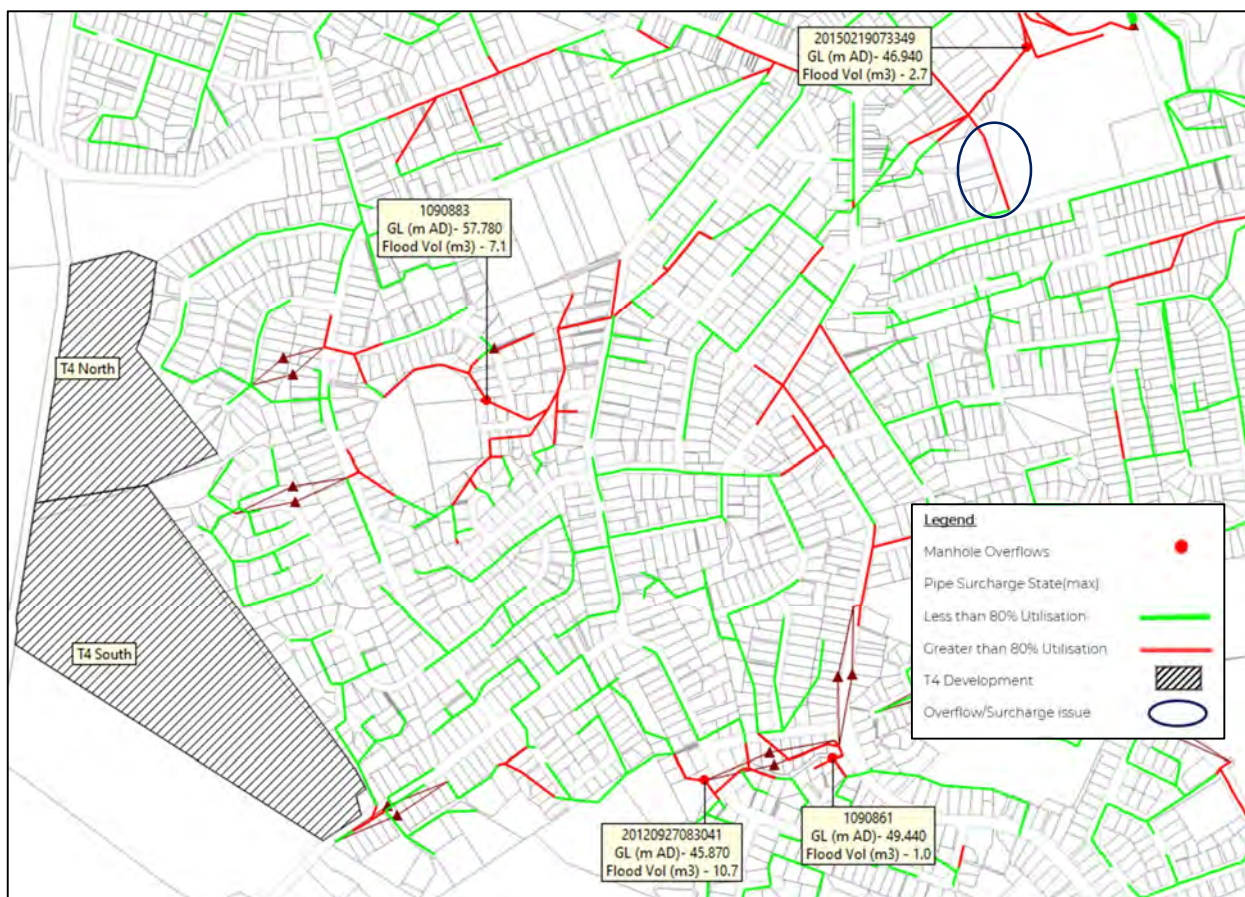


Figure 6-2 LoS results after adding T1, T2 and T9 future developments.

Based on the data presented in Figure 6-2, the capacity of the downstream network of T4 development remains unaffected after the addition of T1, T2, and T9 future developments.

2 provides a high-level overview of the model result with respect to surcharged pipes and overflow within the local network near T4 development as shown in Figure 6-2.

Table 6-2 Scenario 1 simulation Result Overview for 5 years 2 hr design rainfall

Scenario	Number of overflows	Maximum flood volume (m³)	Number of Pipe surcharge
Scenario 1 - Base +T1, T2 & T9 development	4	Manhole 20120927083041 – 10.7	162

6.4 Scenario 2 - Wastewater 2022 base model network with T4 North and T4 South development.

As part of the analysis for the proposed T4 north development, a comprehensive evaluation was conducted on two discharge points. The Level of Service (LoS) results were obtained and analysed for each discharge point to determine their suitability for the development.

The first discharge point for consideration was identified as Manhole 1091129, details in section 6.4.1. This point was carefully evaluated based on various parameters, including the incapacity of the downstream network of the Te Awamutu catchment.

Further details regarding the second discharge point are detailed in section 6.4.2, the discharge point at manhole 1090776.

6.4.1 Option 1 – T4 North Discharge to manhole 1091129

Figure 6-3 shows the addition of T4 development, with the connection point as mentioned in Table 6-3 below.

Table 6-3 Connection point for T4 development

Development	Connection Point	PWWF (l/s)	Pump Discharge (l/s)
T4 North	1091129	5.2	6.5
T4 South	1090696	8.7	4.5

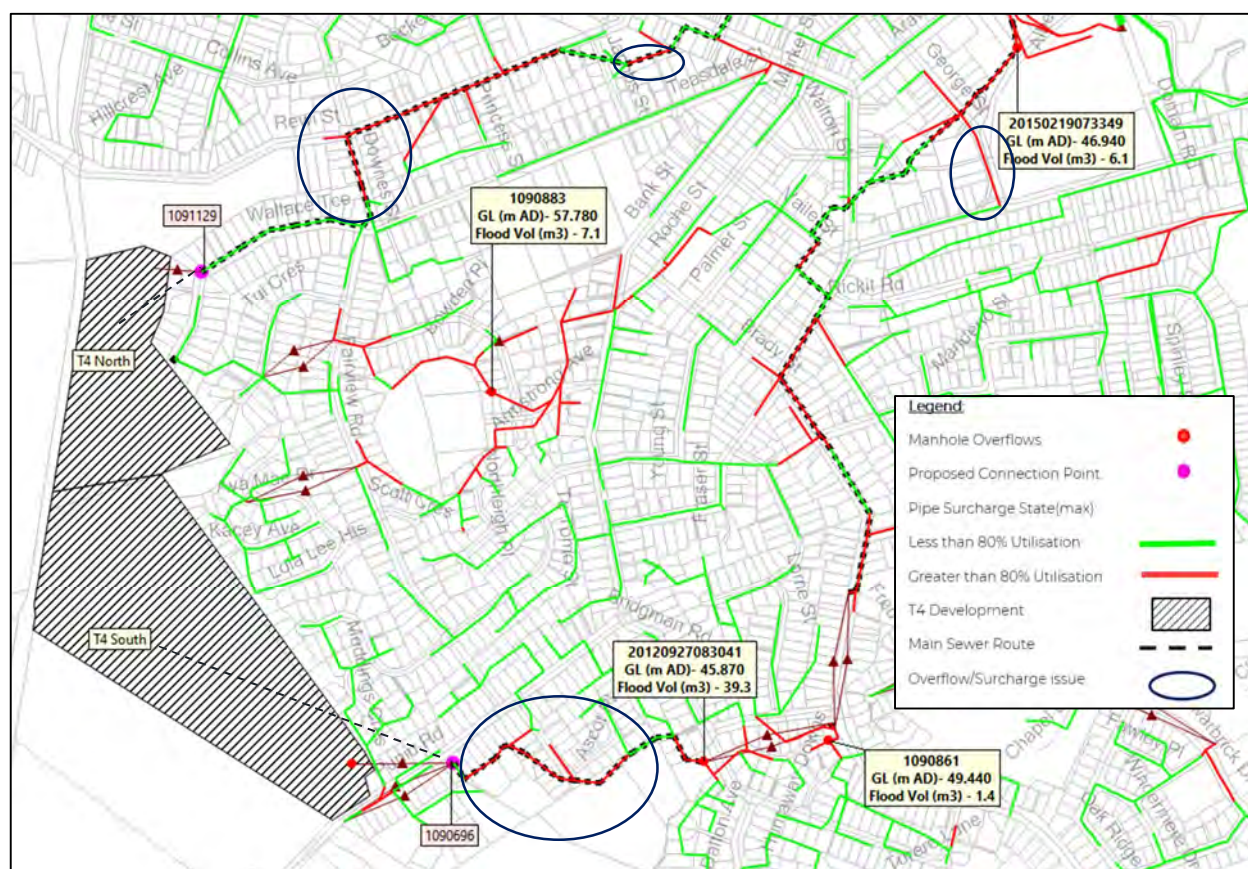


Figure 6-3 LoS results with T4 development (Option 1)

Table 6-4 provides a high-level overview of the model result with respect to surcharged pipes and overflow within the local network near T4 development as shown in Figure 6-3.

Table 6-4 Scenario 2 – Option 1 simulation Result Overview for 5 years 2 hr design rainfall

Scenario 2 – Option 1	Number of overflows	Maximum flood volume (m³)	Number of pipes surcharge
Scenario 2 - +T1, T2, T9 and T4 development	4	Manhole 2012092703041 – 39.3	170

6.4.2 Option 1.1 – T4 North Discharge to manhole 1090776

Figure 6-4 shows the addition of T4 development, with the connection point as mentioned in Table 6-5 below.

Table 6-5 Connection point for T4 development

Development	Connection Point	PWWF (l/s)	Pump Discharge (l/s)
T4 North	1090776	5.2	6.5
T4 South	1090696	8.7	4.5

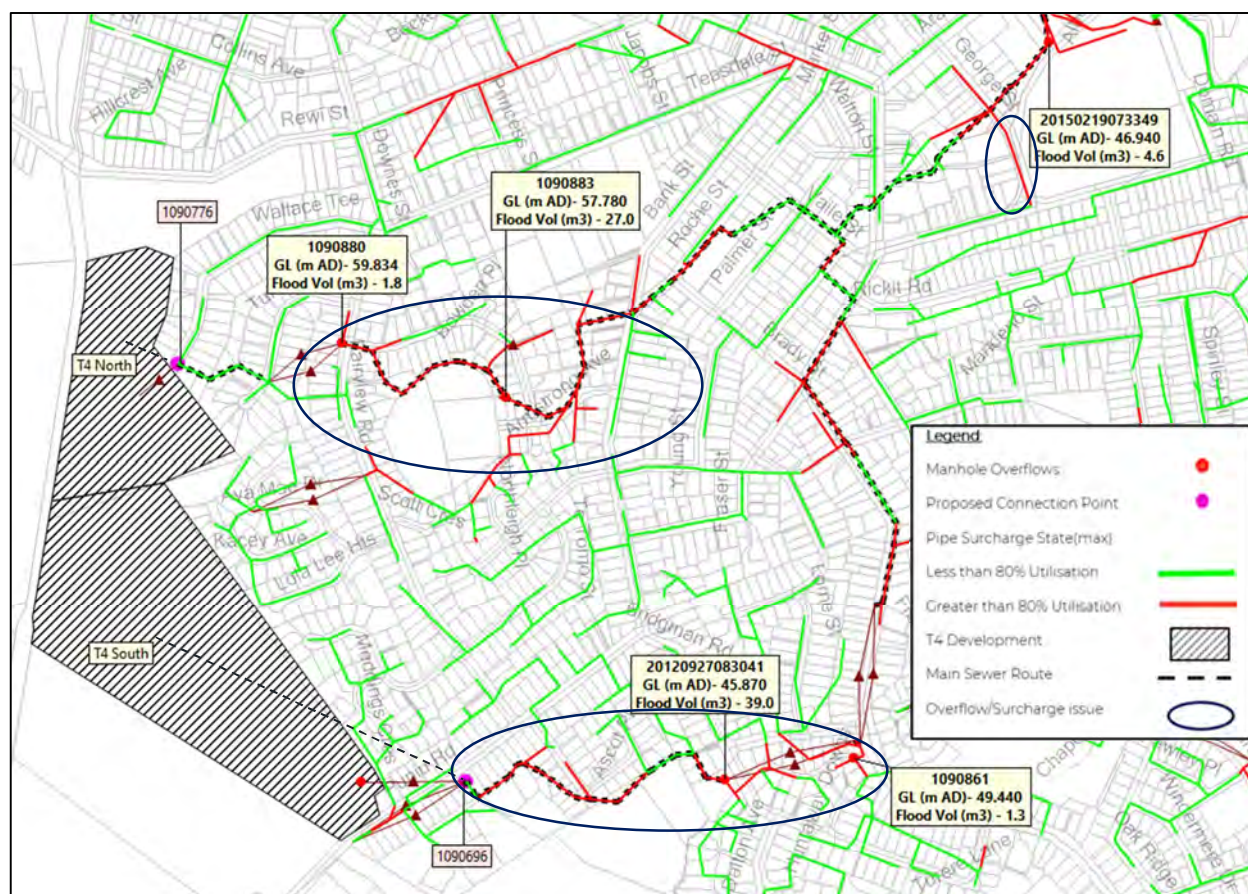


Figure 6-4 LoS results with T4 development (Option 1.1)

Table 6-5 provides a high-level overview of the model result respective to surcharged pipes and overflow within the local network near T4 development as shown in Figure 6-4.

The model results have identified five potential overflows. These overflows are located within the local network near T4 Development, as shown in Figure 6-4. The downstream network from manhole 1090776 has exceeded its pipe capacity leading to a manhole overflow. This is a deviation from the base model.

Table 6-6 Scenario 2 – Option 1.1 simulation Result Overview for 5 years 2 hr design rainfall

Scenario 2 – Option 1.1	Number of overflows	Maximum flood volume (m³)	Number of Pipe surcharge
Scenario 2 - Base +T1, T2, T9 and T4 development	5	Manhole 2012092703041 – 39.0	166

6.4.3 Option 2 – T4 North and T4 South Discharge to manhole 1090776

Figure 6-5 shows the addition of T4 development, with the connection point as mentioned in Table 6-7 below.

Table 6-7 Connection point for T4 development

Development	Connection Point	PWWF (l/s)	Pump Discharge (l/s)
T4 North	1090776	5.2	7
T4 South	1090776	8.7	

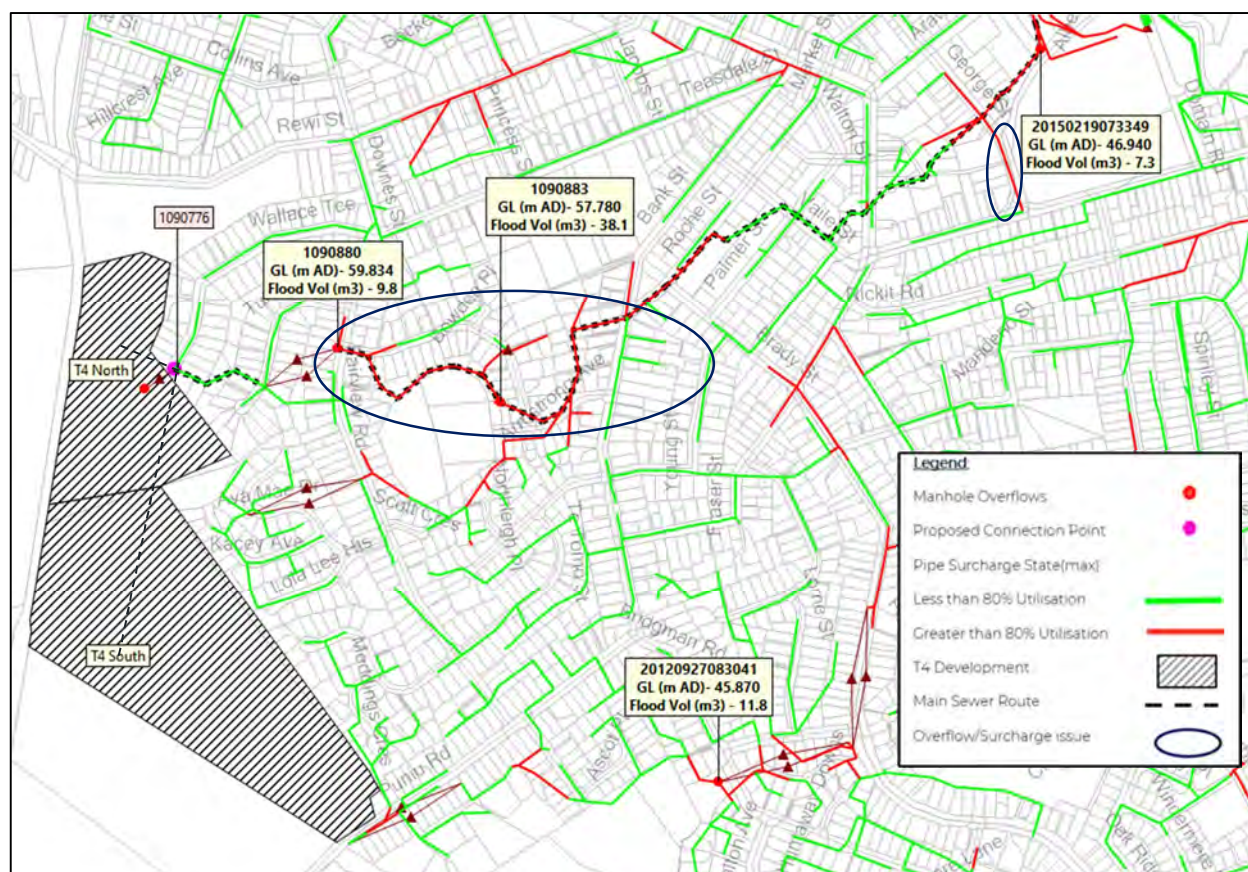


Figure 6-5 LoS results with T4 development (Option 2)

Table 6-8 provides a high-level overview of the model result respective to surcharged pipes and overflow within the local network near T4 development as shown in Figure 6-5.

The model results have identified four potential overflows. These overflows are located within the local network near T4 Development, as shown in Figure 6-5.

The downstream network from manhole 1090776 has exceeded its pipe capacity leading to a manhole overflow. This is a deviation from the base model.

Table 6-8 Scenario 2 – Option 2 simulation Result Overview for 5 years 2 hr design rainfall

Scenario	Number of overflows	Maximum flood volume (m³)	Number of Pipe surge
Scenario 2 - Base +T1, T2, T9 and T4 development	4	Manhole 1090883 – 38.1	163

6.4.4 Option 2.1 – T4 North and T4 South discharges to 1091129

Figure 6-6 shows the addition of T4 development, with the connection point as mentioned in Table 6-9 below.

Table 6-9 Connection point for T4 development

Development	Connection Point	PWWF (l/s)	Pump Discharge (l/s)
T4 North	1091129	5.2	7
T4 South	1091129	8.7	

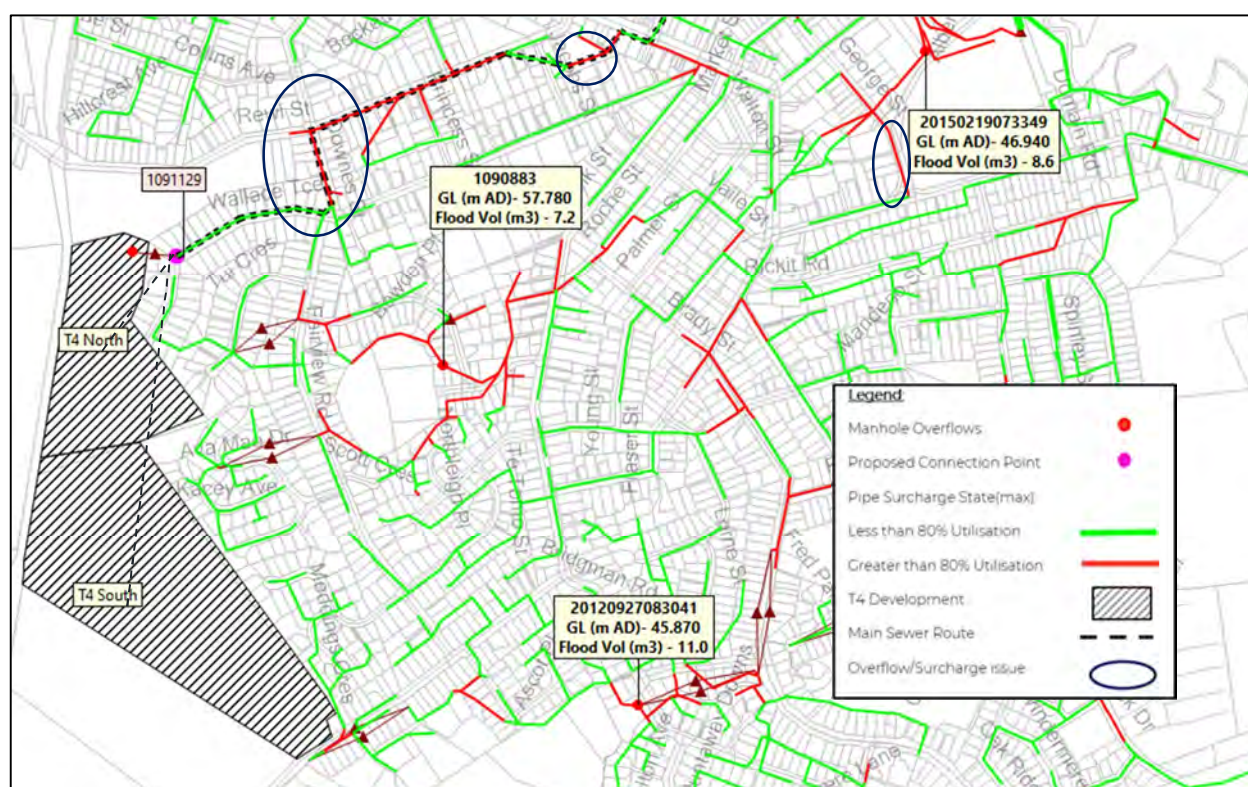


Figure 6-6 LoS results with T4 development (Option 2.1)

Table 6-10 provides a high-level overview of the model result respective to surcharged pipes and overflow within the local network near T4 development as shown in Figure 6-6.

The model results have identified three potential overflows. These overflows are located within the local network near T4 Development, as shown in Figure 6-4. There is an increase in surcharged pipes as detailed in Table 6-10.

Table 6-10 Scenario 2 – Option 2 simulation Result Overview for 5 years 2 hr design rainfall

Scenario	Number of overflows	Maximum flood volume (m ³)	Number of Pipe surcharge
Scenario 2 - Base +T1, T2, T9 and T4 development	3	Manhole 20120927083041– 11.0	173

7 Conclusions

Based on the assessment detailed above, the following conclusions are made.

7.1 Scenario 2 Option 1 – T4 North Discharge to manhole 1091129

A review of the model post-development scenario with a proposed T4 North development flow of 6.5l/s discharged at manhole 10921129 on Wallace Terrace has predicted that the network can cater for the flow.

However, with the proposed T4 south development flow of 4.5l/s discharged at manhole 1090696 on Puniu Road, it is predicted that the network surcharge will increase. The T4 South development fails to meet acceptance criteria for discharge to the WW network at a rate of 4.5l/s.

7.2 Scenario 2 Option 1.1 - T4 North Discharge to manhole 1090776

A review of the model post-development scenario with a proposed T4 North development flow of 6.5l/s (pump rate) discharged at manhole 1090776 on Wallace Terrace has predicted that network surcharge will increase.

Also, with the proposed T4 south development flow of 4.5l/s discharged at manhole 1090696 on Puniu Road, it is predicted that the network surcharge will increase. The T4 South development fails to meet acceptance criteria for discharge to the WW network at a rate of 4.5l/s.

It is noted that the maximum discharge rate from the development is 13.9l/s therefore in theory storage would be required.

7.3 Scenario 2 Option 2 - T4 North and T4 South Discharge to manhole 1090776

A review of the model post-development scenario with a proposed T4 development flow of 7l/s (pump rate) discharged to manhole 1090776 on Wallace Terrace has predicted that network surcharge will increase.

The T4 development fails to meet acceptance criteria for discharge to the WW network at a rate of 7l/s.

It is noted that the maximum discharge rate from the development is 13.9l/s, therefore as the pump rate is lower than this in theory storage would be required.

7.4 Scenario 2 Option 2.1 - T4 North and T4 South discharges to 1091129

A review of the model post-development scenario with a proposed T4 development flow of 7l/s discharged at manhole 1091129 on Wallace Terrace has predicted that network surcharge will increase.

The T4 development fails to meet acceptance criteria for discharge to the WW network at a rate of 7l/s.

It is noted that the maximum discharge rate from the development is 13.9l/s, therefore as the pump rate is lower than this in theory storage would be required.

8 Recommendation

The modelling predicts that T4 flows cannot be directly discharged to the WDC wastewater network at the assessed locations without either storage or network upgrades.

The analysis, which only considers static flow over 24 hours, assumes that the flow rate remains constant throughout the day. Although this approach is appropriate for peak flow and pipe capacity assessment according to RITS, it's essential to consider dynamic flow profiles for a more accurate representation of the flow in the system.

It's important to note that all the options mentioned are likely to be feasible, considering varying degrees of storage and controlled discharge. Alternative feasible solutions that do not require storage would include:

- Upgrading the existing network to allow for full discharge of wastewater flows from the T4 Growth Cell or,
- Identifying alternative rising main alignments to discharge locations that have adequate available capacity.

Neither of these options have been evaluated within this assessment.

9 Disclaimers and Limitations

This report ('Report') has been prepared by WSP New Zealand Limited ('WSP') exclusively for McCaffrey & Cable Consultants Ltd ('Client') about T4 growth cell Development Impact Assessment ('Purpose') and by the form of an instruction for service dated 22 August 2023 ('Agreement'). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any use or reliance on this Report, in whole or in part, for any purpose other than the Purpose or any use or reliance on this Report by any third party.

In preparing this Report, WSP has relied upon data, surveys, analyses, designs, plans, and other information ('Client Data') provided by or on behalf of the Client. Except as otherwise stated in this Report, WSP has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions, and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. WSP will not be liable for any incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented, or otherwise not fully disclosed to WSP.

WSP acknowledges that the limitation that the modelling has not considered potential intensification due to the implementation of the new Medium Residential Density Standards permitting greater intensification by way of Plan Change 26 that WDC has given effect to.

Prepared by:

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Engineer - Wastewater

Reviewed by:

James Cassidy

Technical Principal
Engineer – Water and
Wastewater

APPENDIX 5

WSP WATER MODELLING REPORT

Memorandum

To	Matthew Farrell
Copy	Harry Baxter, Robin Walker, Kristina Macnaughtan, Jivir Viyakesparan
From	Pramodi Galabadage
Office	Hamilton
Date	16 July 2024
File/Ref	3-39701.00
Subject	T4 Development Water Supply Modelling Assessment
Status	Final

1 Introduction

1.1 Background

Waipā District Council (WDC), on behalf of Harrison Grierson, has engaged WSP to carry out a water supply modelling assessment for T4 growth cell in Te Awamutu. The extent of the proposed development is shown in Figure 1-1.



Figure 1-1 : Extent of the proposed T4 development

1.2 Scope

The scope of this assessment is to connect the proposed T4 network with the existing Te Awamutu water supply network and to assess the performance in terms of Level of Services (LoS). This assessment will investigate if the existing water supply network is capable of supplying the proposed development to meet the LoS requirements.

The assessment will also identify any adverse impacts on the existing water supply network.

2 Acceptance Criteria

The following criteria were used for the hydraulic assessment:

- **Level of Service (LoS) – Minimum pressure:** 200 kPa (20 m) pressure at every connection point as requested by WDC.
- **Level of Service (LoS) – Unit Headloss:** Unit Headloss (m/km) of the proposed pipe and the existing supply pipe was also investigated as per NZS 4404:2010.
 - 5 m/km for DN ≤ 150 diameter.
 - 3 m/km for DN ≥ 200 diameter.
- **Fire flow:** New Zealand Fire Service Code of Practice; SNZ PAS 4509:2008 and subsequent amendments, to the satisfaction of the New Zealand Fire Service. Table 2-1 below lists the minimum fire flow requirements (for a single hydrant).

Table 2-1: Fire Flow Requirements as per Fire Fighting Water Supply Code of Practice

Code	Description	Requirements	
		Minimum Fire Flow (L/s)	Minimum Residual Pressure at Required Fire Flow (m)
FW2	Residential	12.5	10

Limitations in the hydraulic modelling software only allow the fire flow analysis for one hydrant at a time. Therefore, WSP has adopted a methodology used for Wellington Water for a similar exercise, this is explained below.

For residential fire flows (FW2), the flow from a single hydrant is used to assess the likely flow from two hydrants. If the average flow is greater than or equal to 25 L/s, the flow from one hydrant meets the FW2 requirements. The use of this approach also creates a buffer to cater for any uncertainty in the models.

Therefore, WSP used the values listed in Table 2-2 to test the fire hydrants.

Table 2-2: Fire Flow Requirements used by WSP in this Assessment

Fire Flow Classification	Minimum Required Flow (L/s)	Minimum Residual Pressure (m)
FW2	25	10

As there is no information available for the hydrants located within the T4 development, WSP will allocate the required fire flow demands onto the connection nodes as exceptional flows.

3 Methodology

3.1 Pipe Connections

As requested by the developer, WSP will follow the following process to connect the proposed T4 development with the existing water supply network. WSP will digitise the proposed connections below into the model:

1. The northern section of T4 will be connected to the existing DN 125 PE (Asset ID: 20220518160526) main on Wallace Terrace.
2. The southern section of T4 will be connected to the existing DN 100 PVC (Asset ID: 3343180) main on Meddings Crescent.

If these two connections do not provide sufficient supply to meet LoS requirements, the below alternative connections will be used.

1. The northern section of T4 will be connected to the existing DN 200 PVC (Asset ID: 3342863) main on Rewi Street.
2. The southern section of T4 will be connected to the existing DN 250 AC (Asset ID: 3340348) main on Puniu Road.

Figure 3-1 shows the proposed connection points (including the alternatives) to the T4 growth cells.



Figure 3-1 : Proposed pipe connections

3.2 Demand Calculations

The Tables below list the peak day demands and fire flow demands used for this assessment, provided by the client.

Table 3-1: T4 demand data

Zone	Catchment Area (Ha)	Total Lots	Population Equiv.	Ave. Flow (L/s)	Peak Flow (L/s)	Fire Flow Demand (L/s)
T4 North	8.99	74	400	1.2	6.02	28.61
T4 South	18.25	118	638	1.92	9.59	30.75
Total	27.24	192	1037	3.12	15.62	34.37

- The total peak demand for T4 North and South catchments will be allocated via single nodes (x2 nodes) connected to the proposed existing pipes.
- The fire demand will be allocated as an exceptional demand at the 60% peak day demand for 30 minutes, see the example in the figure below.

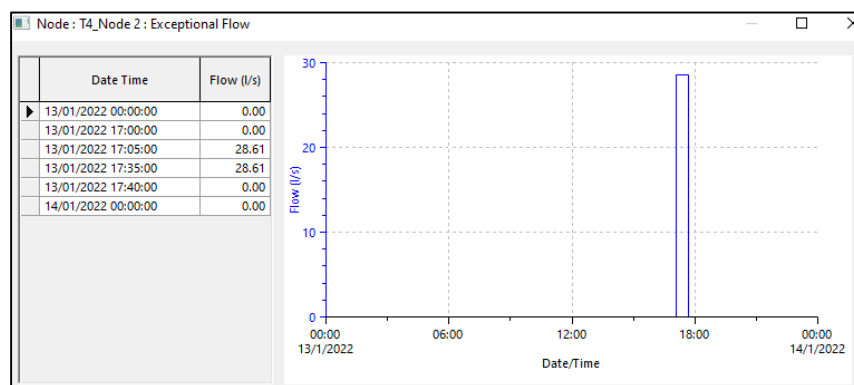


Figure 3-2 : Example of exceptional flow

- LoS and fire flow runs will be carried out and the outcomes will be recorded in this memo.

4 Model Assumptions

The assumptions below have been used in this modelling assessment.

- WSP will be using the 2022 base model for this assessment.
- Full growth demand of T9 will be included in the 2022 base model.
- Demand for T3/Bond Road and T8 must be in the model (not the total demand) as per the GIS update as requested by WDC in the 2022 base model.

5 Modelling Scenarios

Table 5-1 summarises the modelling scenarios, which have been discussed and confirmed with WDC.

Table 5-1: Modelling Scenarios

Scenario	Demand	Model
1	2022 base model demand	WDC 2022 Base Model
2	Scenario 1 + proposed T4 development demands	WDC 2022 Base Model

6 Results

This section discusses the results of the water supply modelling assessment against the acceptance criteria.

6.1 Base Model Results

The base model was tested against the minimum pressure and maximum headloss acceptance criteria. Figure 6-1 shows the results.

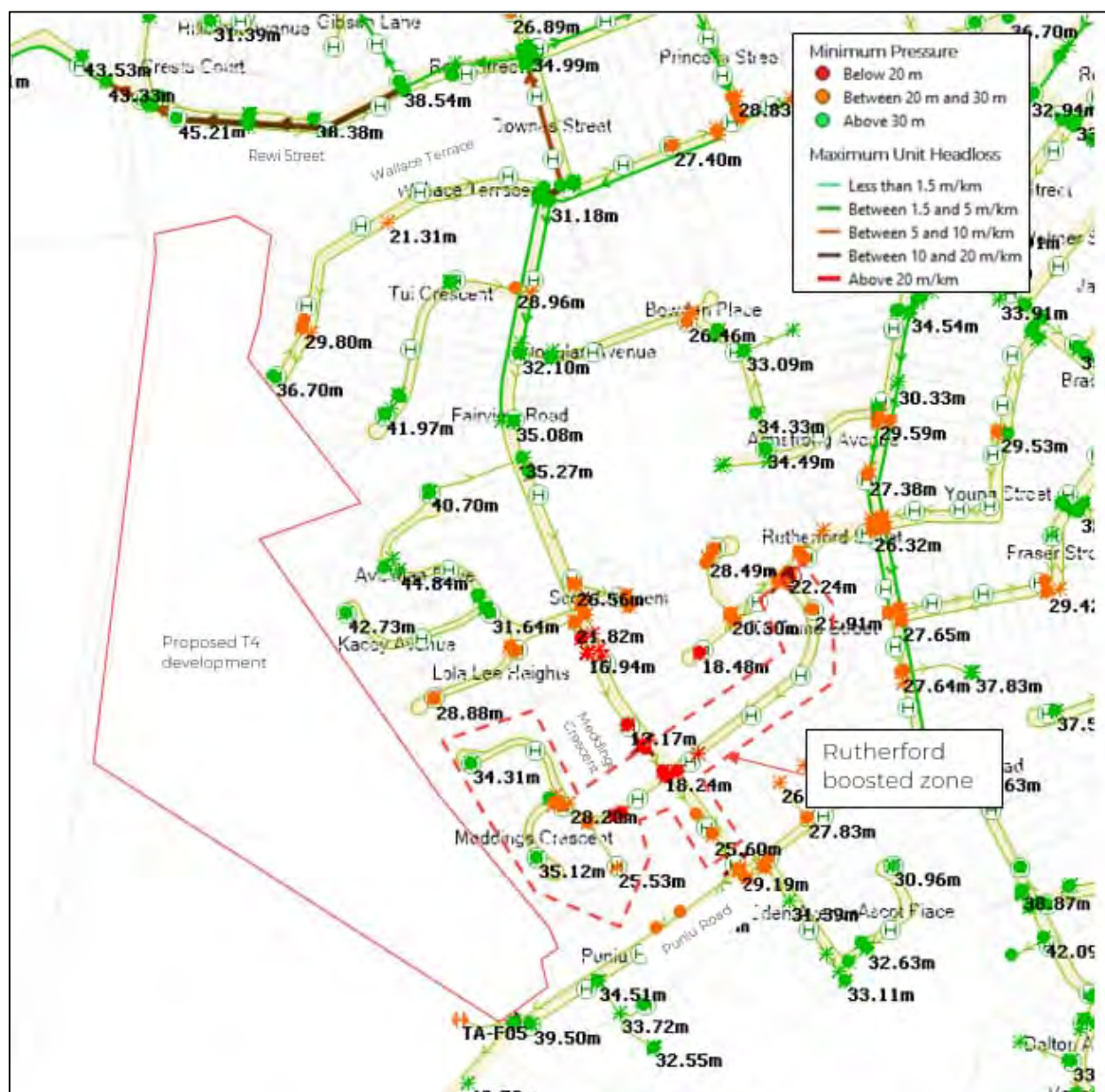


Figure 6-1: LoS results of the base model

As shown in the figure, the localised water supply network maintains mostly maintain a minimum pressure above 30 m. Some areas within the Rutherford boosted area have a minimum pressure less than 20 m during the peak hours, due to the higher ground elevations. This is an existing issue within the Rutherford boosted zone.

The maximum unit headloss of the localised pipe network meets the acceptance criteria as well.

6.2 Base Model Results with T4 Development

This section of the report discusses the LoS and fire flow results of the base model with the addition of T4 development demands.

6.2.1 Option 1 – Proposed Connections

The T4 North and South catchments were connected to the existing network via the supply pipes on Wallace Terrace and Meddings Crescent. The LoS results are shown in Figure 6-2.

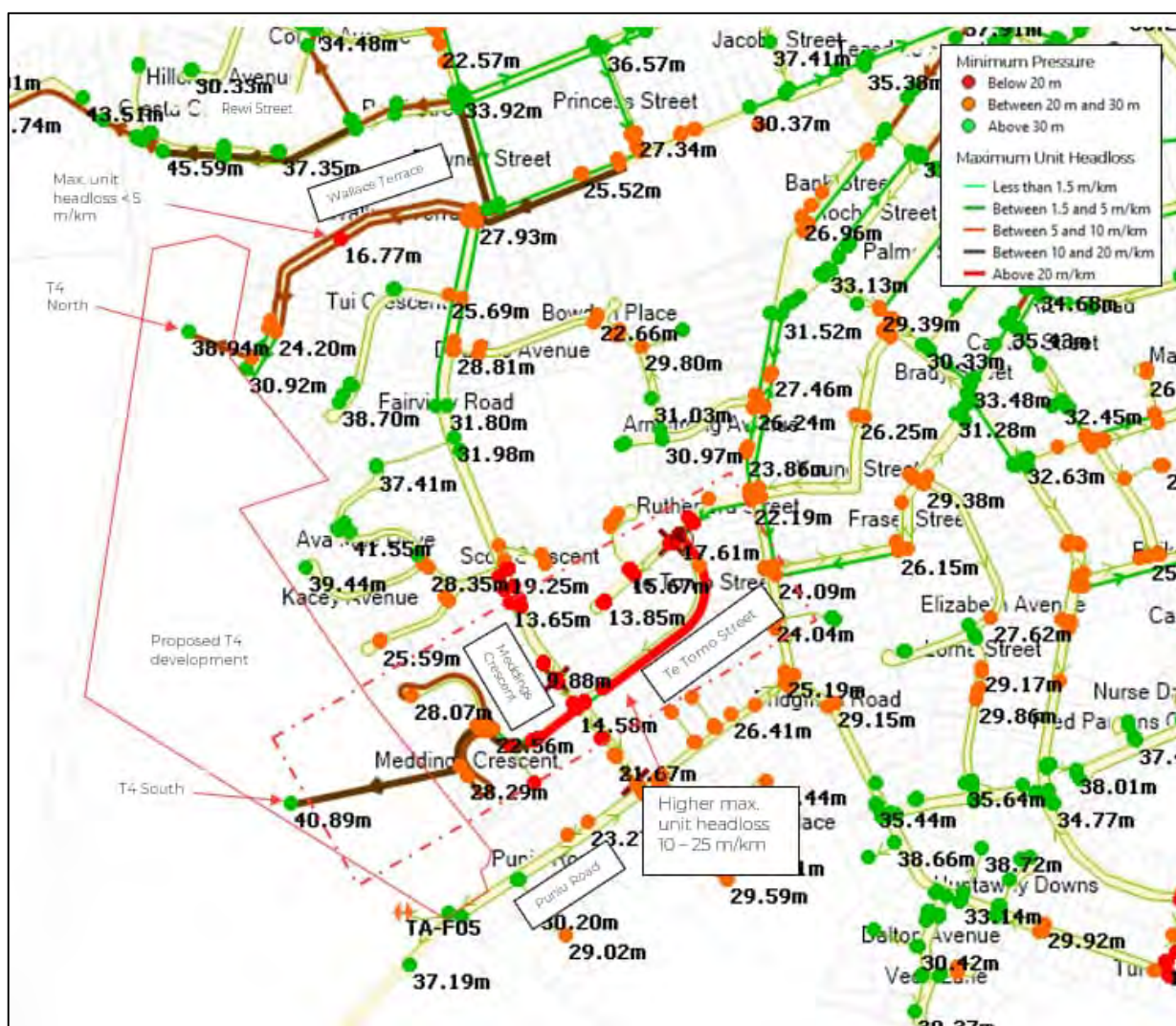


Figure 6-2: LoS results after adding T4 development (option 1)

As shown in the figure above, the minimum pressure of both T4 North and South demand nodes are greater than 20 m, hence meeting the minimum criteria.

Similar to the base model results, the higher elevated areas within the Rutherford boosted zone fail to meet the minimum pressure requirements. This is an existing issue in this area. The minimum pressure has slightly reduced compared to the base model, as a result of the flow going into the T4 South catchment.

In addition, the existing DN 125 PE main on Wallace Terrace exceeds the headloss criteria as the maximum unit headloss is greater than 5 m/km during the evening peak hours. Similarly, the existing DN 100 main on Meddings Crescent experiences a higher unit headloss of 14 m/km during the evening peak hours. In addition, the maximum unit headloss of the existing DN 100 main on Te Tomo Street exceeds 20 m/km.

The next step was to investigate the alternative connections to confirm if better LoS results could be achieved.

6.2.2 Option 2 – Proposed Alternative Connections

This section discusses the LoS and fire flow results of T4 development supplied by the alternative pipe connections.

The alternative DN 125 connections were established from the existing DN 200 PVC main (to T4 North) on Rewi Street and the existing DN 250 AC main (to T4 South) on Puniu Road.

The resulting LoS are shown in Figure 6-3.

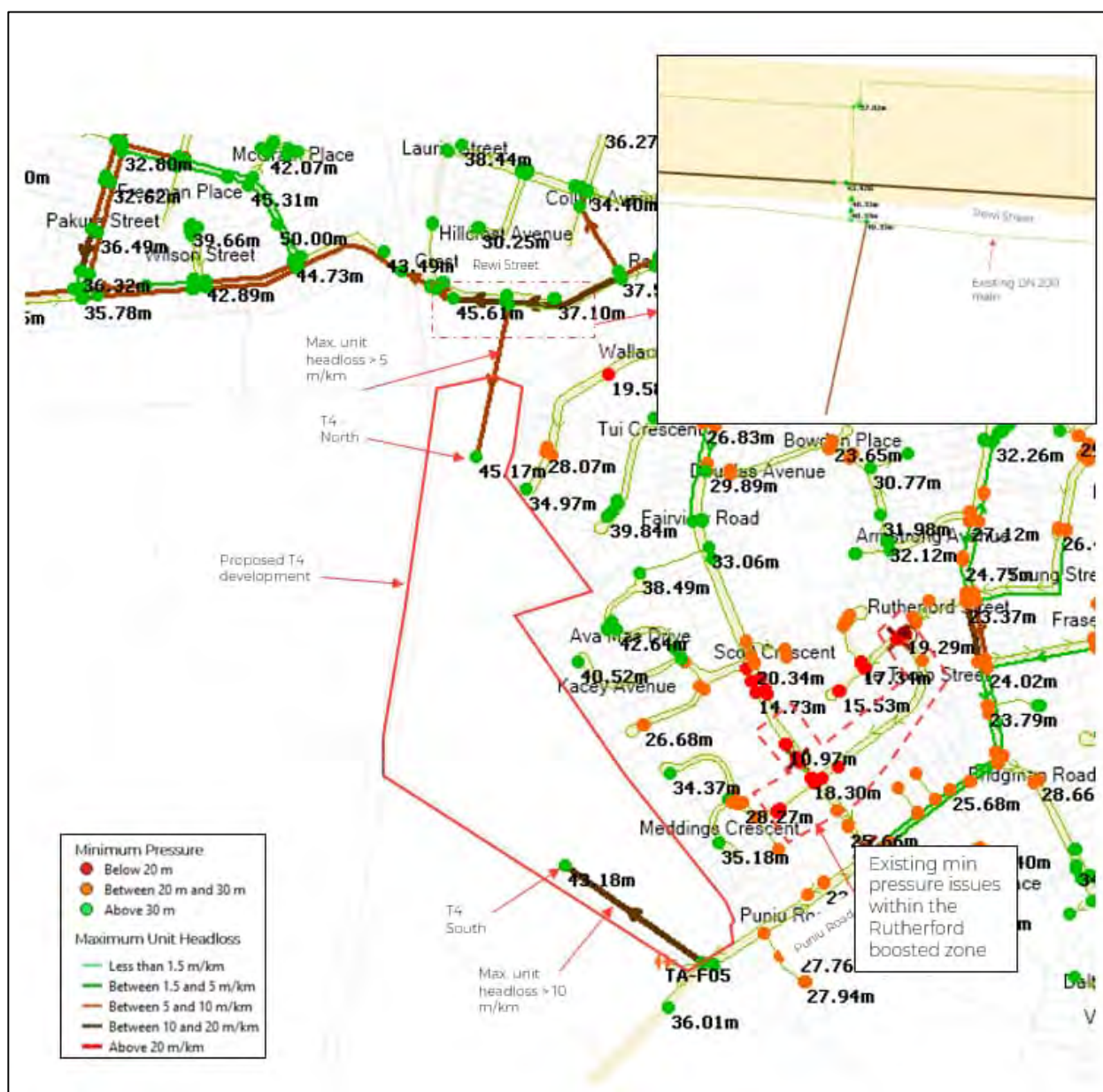


Figure 6-3: LoS results after adding T4 development with alternative connections (option 2)

As shown in the figure, the minimum pressures in both the North and South catchments of T4 development are above 40 m, hence the criteria is met.

The minimum pressures within the site are still greater than 40 m. No other significant changes in the wider network compared to the last scenario.

6.2.3 Fire Flow Results

Fire flow testing was only carried out for option 2.1 which provided the best LoS results (i.e., supply T4 through alternative connections on Rewi Steet and Puniu Road with DN 180 connecting mains).

An exceptional flow of 25 L/s was allocated to both T4 North and South catchments at 60% of the peak day demand. The fire flow demand was added on top of the peak day demand for the development.

The fire flow results are shown in Table 6-1.

Table 6-1: Fire flow results

Catchment	Fire flow achieved (L/s)	Residual pressure at required fire flow (m)
T4 North	28.6	37.7
T4 South	30.7	26.4

As shown in the table above, the required fire flow can be achieved for both North and South catchments while maintaining a residual pressure greater than 10 m. This indicates that the proposed T4 development can meet the FW2 fire flow criteria as per the New Zealand Fire Service Code of Practice; SNZ PAS 4509:2008 and subsequent amendments.

7 Conclusions

WSP has carried out a water supply modelling assessment for the proposed T4 development in Te Awamutu. The purpose of this assessment is to identify if the existing water supply network has the capacity to service the proposed development.

The conclusions from the assessment are listed below.

Baseline

- The base model assessment confirmed that the localised area excluding the Rutherford boosted zone meets LoS requirements (minimum pressure and maximum unit headloss). The higher elevated areas within the Rutherford boosted zone fail to achieve a minimum pressure of 20 m, which has been identified as an existing issue.

Option 1

- The development was then connected with the existing network. T4 North was connected to the existing DN 125 PE main on Wallace Terrace, and T4 South was connected to the existing DN 100 PVC main on Meddings Crescent.
- While the T4 development achieved a minimum pressure greater than 40 m, the existing pipes on Wallace Terrace, Meddings Crescent and Rutherford Road have significantly higher unit headlosses.
- In addition, as the T4 South catchment is supplied through the Rutherford boosted zone, the minimum pressure of the higher elevated areas in the Rutherford boosted zones dropped marginally.

Option 2 and 2.1

- The next step was to connect the T4 growth cell to the alternative connection points on the existing DN 200 PVC main on Rewi St (T4 North) and the existing DN 200 AC main on

Puniu Road (T4 South). Both T4 North and South catchments were connected via DN 125 PE pipes off the existing mains.

- The minimum pressures in the North and South catchments were greater than 40 m. However, the DN 125 (ID 101.5 m m) pipes connecting the catchments don't meet the maximum headloss criteria. Therefore, we increased the connecting pipe size to DN 180 (ID 146.3 m m).
- When the connection pipe size was changed to DN 180, the headloss issues were resolved. Both pipes connecting T4 North and South catchments met the maximum unit headloss criteria. The minimum pressure was still above 40 m.
- The existing minimum pressure issues in the higher elevated areas in the Rutherford boosted zone remain when T4 is connected to the alternative supply mains.
- The fire flow test was carried out for the option which gave the best LoS results (DN 180 connection pipes off the existing DN 200 mains on Rewi Street and Puniu Road). Both T4 North and South catchments achieved the required fire flow while maintaining a residual pressure greater than 10 m.
- Overall, the T4 development with DN 180 connection pipes off the existing DN 200 mains on Rewi Street and Puniu Road, does not have a significant impact on the existing water supply network.

8 Recommendations

The following is recommended.

- DN 180 connection pipes off the existing DN 200 mains on Rewi Street and Puniu Road are recommended to serve the proposed T4 development.
- We recommend carrying out a detailed water supply modelling assessment when the structural layout of the development, finished ground levels and the internal pipe network details are available. This will allow us to further confirm the proposed pipe sizes to connect the T4 development with the existing water supply network. The following scenarios need to be modelled and confirmed.
 - Model the proposed development with the North and South catchments interconnected through the internal pipe network, with the finished ground elevations for each lot.
 - Confirm if the highest elevation lots in the South catchment be fed solely from the existing DN 200 AC main on Punui Road. Confirm if a secondary connection from the North catchment is required otherwise.
 - Confirm if the North catchment can be independently supplied from Wallace Terrace, or if an additional connection through Rewi Street is required.
- In addition, further investigations are recommended for the Rutherford boosted zone, as the higher elevated areas within the zone could be further affected by the additional demands created by the T4 growth cell.

9 Disclaimers and Limitations

This report ('Report') has been prepared by WSP New Zealand Limited ('WSP') exclusively for McCaffrey and Cable Consultants LTD ('Client') in relation to the T4 Development Water Supply Assessment ('Purpose') and in accordance with the form of instruction for service dated 29 September 2023 ('Agreement'). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any use or reliance on this Report, in whole or in part, for any purpose other than the Purpose or for any use or reliance on this Report by any third party.

In preparing this Report, WSP has relied upon data, surveys, analyses, designs, plans, and other information ('Client Data') provided by or on behalf of the Client. Except as otherwise stated in this Report, WSP has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions, and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. WSP will not be liable for any incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented, or otherwise not fully disclosed to WSP.

WSP acknowledges that the limitation that the modelling has not considered potential intensification due to the implementation of the new Medium Residential Density Standards permitting greater intensification by way of Plan Change 26 that WDC has given effect to.

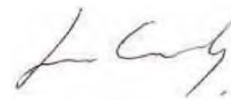
Prepared by:



Pramodi Galabadage

Engineer - Water

Reviewed and Approved
by:



James Cassidy

Work Group Manager –
Water Resources

APPENDIX 6

WASTEWATER NETWORK CALCULATIONS

WASTEWATER ASSESSMENT

EXISTING NETWORK (PRE -DEVELOPMENT)

CLIENT:	Lyn Cudby		
PROJECT NAME:	T4 Structure Plan - 3-Waters Assessment	PAGE NO:	1
PROJECT NO:	A2213321.00	PREPARED BY:	nak
DATE:	30/04/2024	CHECKED BY:	mzf



Factors	
Hamilton Constant	
Water Consumption	200 L/p/Day
Infiltration allowance	2250 L/Hec/Day
Surface Water Ingress	16500 L/Hec/Day
Average Catchment per lot	2200 m2
Colebrook-White coefficient k (mm)	1.5
Peaking Factor (see table 5-1)	
Population equivalent (see table 5-3)	45 people/ha
Persons per dwelling	3

5.2.4.7																															
STREET NAMES	Last Pipe in catchment Pipe ID	Manhole Added Catchment	Pipe Length (MH centres)	Pipe Material	Nom. Dia (internal dia)	Upstream Invert	Downstre am Invert	Pipe Grade	Dwellings (Existing)	MH Catchment Area (2,200m2/lot)	Cumulative Line Catchment	Catchemnt Population (at 3 px/lot)	Cumulative Catchment Population (45 px/Ha)	Peaking Factor (from table 5-1)	ADF Average Daily Flow	PDF Peak Daily Flow	PWWF Peak Wet Weather Flow (L/sec)	Pipe CS Area	Vf Velocity	QF Capacity	SELF CLENSING MINIMUM GRADE CHECK (Table 5-5):	CAPACITY FLOW CHECK	PART FULL				DESIGN CHECK			Available Capacity	
		GIS ID	(m)		(mm)	mRL	mRL	(%)	No	m2	Ha	People		Residential	Commercial	(L/Day)	(L/sec)	(L/sec)	m2	m/s	l/s	0.55% for 150 pipe 0.33% for225 pipe	QF>PWWF	Relative Discharge (Q/Q ₀)	Relative Velocity (V/V _f)	Velocity (V)	Area	Self-cleansing at Full Capacity	Flow at Full Capacity	Self-cleansing at PDF	QF-PWWF
																								(read from chart)	(m/s)	m ²	vel	flow	vel		
Wallace Terrace		1091129	88.100	EW	150	71.570	71.190	0.43%	7	15,400	1.5	21.0	69	6.2		17325.00	1.03	1.33	0.02	0.57	10	Acheives Minimum Grade	QF>PWWF, OK	0.10	0.64	0.37	0.003	RE-DO!	QF>PWWF, OK	Check T.5.5 & T.5.6	8.79
Wallace Terrace		1090570	57.530	EW	150	71.190	70.770	0.73%	5	11,000	2.6	15.0	119	5.3		29700.00	1.53	2.03	0.02	0.75	13	Acheives Minimum Grade	QF>PWWF, OK	0.12	0.66	0.49	0.003	V>0.7m/s, OK	QF>PWWF, OK	Check T.5.5 & T.5.6	11.17
Wallace Terrace		1090571	50.050	EW	150	70.770	70.390	0.76%	4	8,800	3.5	12.0	158	4.8		39600.00	1.85	2.52	0.02	0.76	13	Acheives Minimum Grade	QF>PWWF, OK	0.14	0.69	0.53	0.004	V>0.7m/s, OK	QF>PWWF, OK	Check T.5.5 & T.5.6	10.94
Wallace Terrace		1090572	64.920	EW	150	70.370	63.920	9.94%	8	17,600	5.3	24.0	238	4.1		59400.00	2.39	3.40	0.02	2.77	49	Acheives Minimum Grade	QF>PWWF, OK	0.05	0.50	1.39	0.002	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK	45.57
Wallace Terrace		1090573	61.690	EW	150	63.880	59.120	7.72%	4	8,800	6.2	12.0	277	4.0		69300.00	2.73	3.90	0.02	2.44	43	Acheives Minimum Grade	QF>PWWF, OK	0.06	0.57	1.39	0.002	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK	39.24
Wallace Terrace		1090574	22.260	EW	150	59.050	58.670	1.71%	13	28,600	9.0	39.0	406	3.5		101475.00	3.52	5.25	0.02	1.15	20	Acheives Minimum Grade	QF>PWWF, OK	0.17	0.76	0.87	0.004	V>0.7m/s, OK	QF>PWWF, OK	OK	14.99
Downes street		1090575	31.170	EW	150	58.670	57.620	3.37%	10	22,000	11.2	30.0	505	3.3		126225.00	4.15	6.29	0.02	1.61	28	Acheives Minimum Grade	QF>PWWF, OK	0.15	0.72	1.16	0.004	V>0.7m/s, OK	QF>PWWF, OK	OK	22.18
Downes street		1090576	30.600	EW	150	57.200	56.640	1.83%	5	11,000	12.3	15.0	554	3.3		138600.00	4.56	6.91	0.02	1.19	21	Acheives Minimum Grade	QF>PWWF, OK	0.22	0.80	0.95	0.005	V>0.7m/s, OK	QF>PWWF, OK	OK	14.05
Downes street		1090577	95.210	EW	150	56.620	56.090	0.56%	11	24,200	14.7	33.0	663	3.2		165825.00	5.30	8.11	0.02	0.65	12	Acheives Minimum Grade	QF>PWWF, OK	0.46	0.98	0.64	0.008	RE-DO!	QF>PWWF, OK	OK	3.40
Rewi street		1090578	93.540	EW	150	56.070	55.100	1.04%	23	50,600	19.8	69.0	891	3.1		222750.00	6.91	10.69	0.02	0.89	16	Acheives Minimum Grade	QF>PWWF, OK	0.44	0.97	0.86	0.008	V>0.7m/s, OK	QF>PWWF, OK	OK	5.06
Rewi street		1090579	101.000	EW	150	55.090	53.950	1.13%	16	35,200	23.3	48.0	1049	3.0		262350.00	7.89	12.35	0.02	0.93	16	Acheives Minimum Grade	QF>PWWF, OK	0.48	0.99	0.92	0.009	V>0.7m/s, OK	QF>PWWF, OK	OK	4.09
Rewi street		1090580	43.700	EW	150	53.940	53.610	0.76%	10	22,000	25.5	30.0	1148	3.0		287100.00	8.64	13.51	0.02	0.76	13	Acheives Minimum Grade	RE-DO!	0.64	1.06	0.81	0.011	V>0.7m/s, OK	QF>PWWF, OK	OK	0.09
Rewi street		20220830121134	77.330	EW	150	53.600	52.660	1.22%	42	92,400	34.8	126.0	1564	2.9		391050.00	11.41	18.04	0.02	0.97	17	Acheives Minimum Grade	RE-DO!	0.67	1.07	1.03	0.011	V>0.7m/s, OK	RE-DO!	OK	0.98
Rewi street		1330641	3.640	EW	150	52.160	52.120	1.10%	4	8,800	35.6	12.0	1604	2.9		400950.00	11.69	18.50	0.02	0.92	16	Acheives Minimum Grade	RE-DO!	0.72	1.09	1.00	0.012	V>0.7m/s, OK	RE-DO!	OK	2.28
Rewi street		1090584	15.560	EW	150	52.100	52.030	0.45%	2	4,400	36.1	6.0	1624	2.9		405900.00	11.84	18.73	0.02	0.59	10	Acheives Minimum Grade	RE-DO!	1.15	1.13	0.66	0.018	RE-DO!	RE-DO!	OK	8.39
Through Lots (across Jacobs St)		20220830101124	107.910	EW	225	52.010	51.320	0.64%	1	2,200	36.3	3.0	1634	2.9		408375.00	11.91	18.84	0.04	0.92	36	Acheives Minimum Grade	QF>PWWF, OK	0.33	0.89	0.82	0.015	V>0.7m/s, OK	QF>PWWF, OK	OK	17.58
Through Lot 80		20220830102413	21.960	EW	225	51.300	51.180	0.55%	2	4,400	36.7	6.0	1653	2.9		413325.00	12.06	19.07	0.04	0.85	34	Acheives Minimum Grade	QF>PWWF, OK	0.36	0.92	0.78	0.015	V>0.7m/s, OK	QF>PWWF, OK	OK	14.58
Through car park		20220830073824	97.560	EW	225	52.000	50.310	1.73%	8	17,600	38.5	24.0	1733	2.9		433125.00	12.63	19.99	0.04	1.51	60	Acheives Minimum Grade	QF>PWWF, OK	0.21	0.80	1.21	0.010	V>0.7m/s, OK	QF>PWWF, OK	OK	40.12
Through Lot to Alexander		20220830084905	46.250	EW	225	50.310	50.290	0.04%	10	22,000	40.7	30.0	1832	2.9		457875.00	13.35	21.13	0.04	0.23	9	REDO	RE-DO!	1.43	1.13	0.26	0.050	RE-DO!	RE-DO!	Check T.5.5 & T.5.6	11.82
Alexander Street		20220830084330	63.110	EW	225	50.290	49.660	1.00%	2	4,400	41.1	6.0	1851	2.9		462825.00	13.50	21.36	0.04	1.15	46	Acheives Minimum Grade	QF>PWWF, OK	0.30	0.87	1.00	0.014	V>0.7m/s, OK	QF>PWWF, OK	OK	24.22

MZF Check																															
Catchment 1	1330649	1090576	31.170	Conc	150	58.670	57.620	3.37%	60	120,879	12.1	180.0	544	3.3		135988.88	4.47	6.78	0.02	1.61	28	Acheives Minimum Grade	QF>PWWF, OK	0.16	0.73	1.17	0.004	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK	21.69
Catchment 2	1330646	1090579	93.540	EW	150	56.070	55.100	1.04%	30	67,291	18.8	90.0	847	3.1		211691.25	6.57	10.16	0.02	0.89	16	Acheives Minimum Grade	QF>PWWF, OK	0.42	0.96	0.86	0.008	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK	5.59
Catchment 3	1330645	2041004	101.000	EW	150	55.090	53.950	1.13%	28	54,269	24.2	84.0	1091	3.0		272743.88	8.21	12.84	0.02	0.93	16	Acheives Minimum Grade	QF>PWWF, OK	0.50	0.99	0.92	0.009	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK	3.60
Catchment 4	1330644	20220830121134	43.700	EW	150	53.940	53.610	0.76%	8	13,968	25.6	24.0	1154	3.0		288457.88	8.68	13.58	0.02	0.76	13	Acheives Minimum Grade	RE-DO!	0.65	1.06	0.81	0.011	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK	0.15
Catchment 5	20220830083908	20220830122730	77.330	PL-EW	150	53.600	52.660	1.22%	10	19,416	27.6	30.0	1241	3.0		310300.88	9.34	14.61	0.02	0.97	17	Acheives Minimum Grade	QF>PWWF, OK	0.55	1.02	0.98	0.009	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK	2.46
Catchment 6	20220830082626	20220830125528	95.160	PL-EW	150	52.650	52.180	0.49%	42	101,341	37.7	126.0	1697	2.9		424309.50	12.38	19.58	0.02	0.61	11	Acheives Minimum Grade	RE-DO!	1.14	1.13	0.69	0.018	RE-DO!	RE-DO!	Self-cleaning, OK	8.74
Catchment 7	1330641	1090584	3.640	EW	150	52.160	52.120	1.10%	6	9,767	38.7	18.0	1741	2.9		435297.38	12.70	20.09	0.02	0.92	16	Acheives Minimum Grade	RE-DO!	0.78	1.11	1.02	0.012	V>0.7m/s, OK	RE-DO!	Self-cleaning, OK	3.87
	1330640		15.560	EW	150	52.100	52.030	0.45%			38.7	0.0	1741	2.9		435297.38	12.70	20.09	0.02	0.59	10	Acheives Minimum Grade	RE-DO!	1.23	1.13	0.66	0.019	RE-DO!	RE-DO!	Self-cleaning, OK	9.75
Catchment 8	20220830101124	20220830130203	107.910	EW	225	52.010	51.320	0.64%	6	14,103	40.1	18.0	1805	2.9		451163.25	13.16	20.82	0.04	0.92	36	Acheives Minimum Grade	QF>PWWF, OK	0.36	0.92	0.84	0.016	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK	15.61
Catchment 9	20220830102413	20220830130755	21.960	EW	225	51.300	51.180	0.55%	2	2,522	40.4	6.0	1816	2.9		454000.50	13.24	20.95	0.04	0.85	34	Acheives Minimum Grade	QF>PWWF, OK	0.39	0.94	0.80	0.017	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK	12.71
Catchment 10	20220830073824	20220830140812	97.560	EW	225	52.000	50.310	1.73%	5	8,227	41.2	15.0	1853	2.9		463255.88	13.51	21.38	0.04	1.51	60	Acheives Minimum Grade	QF>PWWF, OK	0.22	0.81	1.22	0.011	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK	38.73
Catchment 11	20220830084905	20220830141322	46.250	EW	225	50.310	50.290	0.04%	13	23,570	43.5	39.0	1959	2.9		489772.13	14.29	22.60	0.04	0.23	9	REDO	RE-DO!	1.53	1.13	0.26	0.054	RE-DO!	RE-DO!	Check T.5.5 & T.5.6	13.29

WASTEWATER ASSESSMENT EXISTING NETWORK - T4 WWPS DISCHARGING 13.1 L/S TO WALLACE TERRACE (MH 1091129)

CLIENT:	Lyn Cudby		
PROJECT NAME:	T4 Structure Plan - 3-Waters Assessment	PAGE NO:	1
PROJECT NO:	A2213321.00	PREPARED BY:	nak
DATE:	30/04/2024	CHECKED BY:	mzf



Factors	
Hamilton Constant	
Water Consumption	200 L/p/Day
Infiltration allowance	2250 L/Hec/Day
Surface Water Ingress	16500 L/Hec/Day
Average Catchment per lot	2200 m2
Colebrook-White coefficient k (mm)	1.5
Peaking Factor (see table 5-1)	
Population equivalent (see table 5-3)	45 people/ha
Persons per dwelling	3

STREET NAMES		Asset ID	Pipe Length (MH centres)	Pipe Material	Nom. Dia (internal dia)			Pipe Grade	Dwellings (Existing)	MH Catchment Area (2,200m2/lot)	Cumulative Line Catchment	Catchemnt Population (at 3 px/lot)	Cumulative Catchment Population (45 px/Ha)	Peaking Factor (from table 5-1)		ADF Average Daily Flow	PDF Peak Daily Flow	PWWF Peak Wet Weather Flow (L/sec)	Pipe CS Area	VF Velocity	QF Capacity	SELF CLENSING MINIMUM GRADE CHECK (Table 5-5):	CAPACITY FLOW CHECK	PART FULL				DESIGN CHECK		
			(m)		(mm)			(%)		m2	Ha	People		Residential	Commercial	(L/Day)	(L/sec)	(L/sec)	m2	m/s	l/s	0.55% for 150 pipe 0.33% for 225 pipe	QF>PWWF	Relative Discharge (Q/Qc)	Relative Velocity (V/Vc)	Velocity (V)	Area	Self-cleansing at Full Capacity	Flow at Full Capacity	Self-cleansing at PDF
																								(read from chart)	(m/s)	m ²	vel	flow	vel	
														Pumped flow into network			13.10	13.10												
Wallace Terrace		1091129	88.100	EW	150	71.570	71.190	0.43%	7	15,400	1.5	21.0	69			17325.00	14.13	14.43	0.02	0.57	10	Acheives Minimum Grade	RE-DO!	1.40	1.13	0.65	0.022	RE-DO!	RE-DO!	Self-cleaning, OK
Wallace Terrace		1090570	57.530	EW	150	71.190	70.770	0.73%	5	11,000	2.6	15.0	119	5.3		29700.00	14.63	15.13	0.02	0.75	13	Acheives Minimum Grade	RE-DO!	1.11	1.13	0.84	0.017	V>0.7m/s, OK	RE-DO!	Self-cleaning, OK
Wallace Terrace		1090571	50.050	EW	150	70.770	70.390	0.76%	4	8,800	3.5	12.0	158	4.8		39600.00	14.95	15.62	0.02	0.76	13	Acheives Minimum Grade	RE-DO!	1.11	1.13	0.86	0.017	V>0.7m/s, OK	RE-DO!	Self-cleaning, OK
Wallace Terrace		1090572	64.920	EW	150	70.370	63.920	9.94%	8	17,600	5.3	24.0	238	4.1		59400.00	15.49	16.50	0.02	2.77	49	Acheives Minimum Grade	QF>PWWF, OK	0.32	0.88	2.44	0.006	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK
Wallace Terrace		1090573	61.690	EW	150	63.880	59.120	7.72%	4	8,800	6.2	12.0	277	4.0		69300.00	15.83	17.00	0.02	2.44	43	Acheives Minimum Grade	QF>PWWF, OK	0.37	0.92	2.25	0.007	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK
Wallace Terrace		1090574	22.260	EW	150	59.050	58.670	1.71%	13	28,600	9.0	39.0	406	3.5		101475.00	16.62	18.35	0.02	1.15	20	Acheives Minimum Grade	QF>PWWF, OK	0.82	1.11	1.27	0.013	V>0.7m/s, OK	QF>PWWF, OK	OK
Downes street		1090575	31.170	EW	150	58.670	57.620	3.37%	10	22,000	11.2	30.0	505	3.3		126225.00	17.25	19.39	0.02	1.61	28	Acheives Minimum Grade	QF>PWWF, OK	0.61	1.05	1.69	0.010	V>0.7m/s, OK	QF>PWWF, OK	OK
Downes street		1090576	30.600	EW	150	57.200	56.640	1.83%	5	11,000	12.3	15.0	554	3.3		138600.00	17.66	20.01	0.02	1.19	21	Acheives Minimum Grade	QF>PWWF, OK	0.84	1.12	1.33	0.013	V>0.7m/s, OK	QF>PWWF, OK	OK
Downes street		1090577	95.210	EW	150	56.620	56.090	0.56%	11	24,200	14.7	33.0	663	3.2		165825.00	18.40	21.21	0.02	0.65	12	Acheives Minimum Grade	RE-DO!	1.60	1.13	0.74	0.025	RE-DO!	RE-DO!	OK
Rewi street		1090578	93.540	EW	150	56.070	55.100	1.04%	23	50,600	19.8	69.0	891	3.1		222750.00	20.01	23.79	0.02	0.89	16	Acheives Minimum Grade	RE-DO!	1.27	1.13	1.01	0.020	V>0.7m/s, OK	RE-DO!	OK
Rewi street		1090579	101.000	EW	150	55.090	53.950	1.13%	16	35,200	23.3	48.0	1049	3.0		262350.00	20.99	25.45	0.02	0.93	16	Acheives Minimum Grade	RE-DO!	1.28	1.13	1.05	0.020	V>0.7m/s, OK	RE-DO!	OK
Rewi street		1090580	43.700	EW	150	53.940	53.610	0.76%	10	22,000	25.5	30.0	1148	3.0		287100.00	21.74	26.61	0.02	0.76	13	Acheives Minimum Grade	RE-DO!	1.62	1.13	0.86	0.025	V>0.7m/s, OK	RE-DO!	OK
Rewi street		20220830121134	77.330	EW	150	53.600	52.660	1.22%	42	92,400	34.8	126.0	1564	2.9		391050.00	24.51	31.14	0.02	0.97	17	Acheives Minimum Grade	RE-DO!	1.44	1.13	1.09	0.022	V>0.7m/s, OK	RE-DO!	OK
Rewi street		1330641	3.640	EW	150	52.160	52.120	1.10%	4	8,800	35.6	12.0	1604	2.9		400950.00	24.79	31.60	0.02	0.92	16	Acheives Minimum Grade	RE-DO!	1.53	1.13	1.04	0.024	V>0.7m/s, OK	RE-DO!	OK
Rewi street		1090584	15.560	EW	150	52.100	52.030	0.45%	8	17,600	37.4	24.0	1683	2.9		420750.00	25.37	32.51	0.02	0.59	10	Acheives Minimum Grade	RE-DO!	2.45	1.13	0.66	0.038	RE-DO!	RE-DO!	OK
Through Lots (across Jacobs St)		20220830101124	107.910	EW	225	52.010	51.320	0.64%	1	2,200	37.6	3.0	1693	2.9		423225.00	25.44	32.63	0.04	0.92	36	Acheives Minimum Grade	QF>PWWF, OK	0.70	1.08	0.99	0.026	V>0.7m/s, OK	QF>PWWF, OK	OK
Through Lot 80		20220830102413	21.960	EW	225	51.300	51.180	0.55%	2	4,400	38.1	6.0	1713	2.9		428175.00	25.59	32.86	0.04	0.85	34	Acheives Minimum Grade	QF>PWWF, OK	0.76	1.10	0.93	0.027	V>0.7m/s, OK	QF>PWWF, OK	OK
Through car park		20220830073824	97.560	EW	225	52.000	50.310	1.73%	8	17,600	39.8	24.0	1792	2.9		447975.00	26.17	33.77	0.04	1.51	60	Acheives Minimum Grade	QF>PWWF, OK	0.44	0.97	1.47	0.018	V>0.7m/s, OK	QF>PWWF, OK	OK
Through Lot to Alexander		20220830084905	46.250	EW	225	50.310	50.290	0.04%	10	22,000	42.0	30.0	1891	2.9		472725.00	26.89	34.91	0.04	0.23	9	REDO	RE-DO!	2.89	1.13	0.26	0.102	RE-DO!	RE-DO!	Check T.5.5 & T.5.6
Alexander Street		20220830084330	63.110	EW	225	50.290	49.660	1.00%	2	4,400	42.5	6.0	1911	2.9		477675.00	27.03	35.14	0.04	1.15	46	Acheives Minimum Grade	QF>PWWF, OK	0.59	1.04	1.19	0.023	V>0.7m/s, OK	QF>PWWF, OK	OK

MZF Check																	13.10	13.10													
Catchment 1	1330649	1090576	31.170	Conc	150	58.670	57.620	3.37%	60	120,879	12.1	180.0	544	3.3		135988.88	17.57	19.88	0.02	1.61	28	Acheives Minimum Grade	QF>PWWF, OK	0.62	1.05	1.69	0.010	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK	8.59
Catchment 2	1330646	1090579	93.540	EW	150	56.070	55.100	1.04%	30	67,291	18.8	90.0	847	3.1		211691.25	19.67	23.26	0.02	0.89	16	Acheives Minimum Grade	RE-DO!	1.25	1.13	1.01	0.020	V>0.7m/s, OK	RE-DO!	Self-cleaning, OK	7.51
Catchment 3	1330645	2041004	101.000	EW	150	55.090	53.950	1.13%	28	54,269	24.2	84.0	1091	3.0		272743.88	21.31	25.94	0.02	0.93	16	Acheives Minimum Grade	RE-DO!	1.30	1.13	1.05	0.020	V>0.7m/s, OK	RE-DO!	Self-cleaning, OK	9.50
Catchment 4	1330644	20220830121134	43.700	EW	150	53.940	53.610	0.76%	8	13,968	25.6	24.0	1154	3.0		288457.88	21.78	26.68	0.02	0.76	13	Acheives Minimum Grade	RE-DO!	1.62	1.13	0.86	0.025	V>0.7m/s, OK	RE-DO!	Self-cleaning, OK	13.25
Catchment 5	20220830083908	20220830122730	77.330	PL-EW	150	53.600	52.660	1.22%	10	19,416	27.6	30.0	1241	3.0		310300.88	22.44	27.71	0.02	0.97	17	Acheives Minimum Grade	RE-DO!	1.32	1.13	1.09	0.021	V>0.7m/s, OK	RE-DO!	Self-cleaning, OK	10.64
Catchment 6	20220830082626	20220830125528	95.160	PL-EW	150	52.650	52.180	0.49%	42	101,341	37.7	126.0	1697	2.9		424309.50	25.48	32.68	0.02	0.61	11	Acheives Minimum Grade	RE-DO!	2.35	1.13	0.69	0.037	RE-DO!	RE-DO!	Self-cleaning, OK	21.84
Catchment 7	1330641	1090584	3.640	EW	150	52.160	52.120	1.10%	6	9,767	38.7	18.0	1741	2.9		435297.38	25.80	33.19	0.02	0.92	16	Acheives Minimum Grade	RE-DO!	1.59	1.13	1.04	0.025	V>0.7m/s, OK	RE-DO!	Self-cleaning, OK	16.97
	1330640		15.560	EW	150	52.100	52.030	0.45%		-	38.7	0.0	1741	2.9		435297.38	25.80	33.19	0.02	0.59	10	Acheives Minimum Grade	RE-DO!	2.50	1.13	0.66	0.039	RE-DO!	RE-DO!	Self-cleaning, OK	22.85
Catchment 8	20220830101124	20220830130203	107.910	EW	225	52.010	51.320	0.64%	6	14,103	40.1	18.0	1805	2.9		451163.25	26.26	33.92	0.04	0.92	36	Acheives Minimum Grade	QF>PWWF, OK	0.72	1.09	1.00	0.026	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK	2.51
Catchment 9	20220830102413	20220830130755	21.960	EW	225	51.300	51.180	0.55%	2	2,522	40.4	6.0	1816	2.9		454000.50	26.34	34.05	0.04	0.85	34	Acheives Minimum Grade	RE-DO!	0.78	1.11	0.94	0.028	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK	0.99
Catchment 10	20220830073824	20220830140812	97.560	EW	225	52.000	50.310	1.73%	5	8,227	41.2	15.0	1853	2.9		463255.88	26.61	34.48	0.04	1.51	60	Acheives Minimum Grade	QF>PWWF, OK	0.44	0.97	1.47	0.018	V>0.7m/s, OK	QF>PWWF, OK	Self-cleaning, OK	25.63
Catchment 11	20220830084905	20220830141322	46.250	EW	225	50.310	50.290	0.04%	13	23,570	43.5	39.0	1959	2.9		489772.13	27.39	35.70	0.04	0.23	9	REDO	RE-DO!	2.94	1.13	0.26	0.104	RE-DO!	RE-DO!	Check T.5.5 & T.5.6	26.39

